Team Scaffolds: How Minimal Team Structures Enable Role-based Coordination

Team Scaffolds: How Minimal Team Structures Enable Role-based Coordination

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ABSTRACT

In this dissertation, I integrate research on role-based coordination with concepts adapted from the team effectiveness literature to theorize how minimal team structures support effective coordination when people do not work together regularly. I argue that role-based coordination among relative strangers can be interpersonally challenging and propose that team scaffolds (minimal team structures that bound groups of roles rather than groups of individuals) may provide occupants with a temporary shared in-group that facilitates interaction. I develop and test these ideas in a multi-method, multi-site field study of a new work structure, called pods, that were implemented in many hospital emergency departments (EDs) and were sometimes designed to function as team scaffolds.

In chapter 3, I conduct an in-depth study of team scaffolds in one ED. I adapt network methods to compare coordination patterns before and after team scaffolds were implemented. My results show that the team scaffolds improve performance, in part by reducing the number of partners with whom each role occupant coordinates. Second, I analyze qualitative interview data to theorize the social experience of working in team scaffolds. Team scaffolds provided a shared in-group that supported a sense of belonging and reduced interpersonal risk.

In chapter 4, I implement a cross-case comparison of pod design at two additional EDs. The pods at the comparative sites achieved some of the enabling conditions (proximity and boundedness) identified at the first ED, but did not scaffold group-level coordination. Instead other informal groupings felt like meaningful teams. The way that work was allocated at the two comparative EDs created a misalignment of ownership and interests between nurses and physicians, undermining the sense of teamness.

In chapter 5, I conduct a quantitative analysis of pod performance at the three field sites. I consider the effect of the relatively stable resources in each pod and also the relational patterns that accumulate in each pod on operational performance. Within-shift shared patients is associated with operational performance, even though lifetime shared patients is not.

Work teams are becoming less bounded and stable and my dissertation provides insight and evidence on the conditions under which relative strangers can identify as and function as a minimal team. I identify structures and mechanisms that enable teaming among hyper-fluid groups of people, and also demonstrate the importance of aligned ownership of work in how people make sense of teams in their work lives.

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CHAPTER 1. INTRODUCTION

On an ordinary weekday afternoon in the Emergency Department at City Hospital, technicians, nurses, and physicians were actively communicating and coordinating. They called out to each other with updates, stating next steps for treating each patient:

> "Who has [patient] White? I need a BP[1]."
> "I got it!"
> "That's all we need, and then she can go."
>
> "Hey, labs are back for Reyes. Did you see her K[2] is high?"
> "Let me see."
>
> "I need help NOW!"
> "Coming!"
> "Coming!"
> "What's going on?" -excerpts from field notes

This group of highly-trained knowledge workers had not worked together before. Yet remarkably, they were able to engage in sustained group-level coordination over the course of the day, even when someone would finish his shift and a new person would join the group. Each person had a specific professional role, and together they worked in a *team scaffold* – a minimal team structure that explicitly bounded a small group of roles and assigned it group-level ownership for the work.

The evolving nature of teams and teamwork in today's fast-paced flexible work environments (e.g., emergency departments, crisis response organizations, new product development teams) makes understanding the potential effectiveness of minimal team structures extremely relevant (Edmondson & Nembhard, 2009; Faraj & Xiao, 2006;

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[1] BP is an abbreviation for blood pressure test.
[2] K is an abbreviation for the level of potassium in a patients' blood, as reported in a lab test.

Hackman & Katz, 2010). On the one hand, people can be left to flexibly work out the coordination of interdependent work using individual role interdependencies as the coordinating mechanism. This is a basic premise of role theory (e.g., Klein, Ziegert, Knight, & Xiao, 2006). On the other hand, organizing people into a team scaffold with entirely fluid membership might provide some of the coordinating advantages of what Hackman called "real teams"—that is, stable bounded teams (Hackman, 2002, pg. 37). Prior theory and research do not answer the question of whether and how team scaffolds could improve coordination or performance outcomes among temporary collaborators, over and above role-based coordination. That is the aim of this dissertation.

Integrating Role Theory and Team Effectiveness Theory

As a foundation for arguing that team scaffolds significantly affect temporary collaborators, I review two relevant research streams – role-based coordination and team effectiveness. Neither stream fully explains this phenomenon; I thus integrate them to build theory on the design, functioning, and effects of team scaffolds. Role theory helps explain how relative strangers can coordinate complex tasks. Roles delineate expertise and responsibility so that anyone in a particular role will know her individual responsibilities and her interdependencies with those in other roles, even in the absence of interpersonal familiarity (Bechky 2006; Griffin et al. 2007). Roles and role structures thus allow coordination to be de-individualized: people do not rely on knowing others' unique skills, weaknesses, or preferences to figure out how to work together; instead they rely on knowing one another's position in the role structure (Klein et al., 2006). Indeed many studies show, and many operating environments rely on, the efficacy of roles in facilitating non-programmed coordination in dynamic settings like fire-fighting, trauma departments, or film crews (Bechky 2006; Bigley and Roberts 2001; Klein et al. 2006).

Role structures organize the actions of fluid or temporary personnel through pre-defined task divisions, rather than through the patterns built up through experience working out interdependences and interrelationships. Yet, as fluid groups of people confront a shared task, social identities and intergroup dynamics may inhibit their interactions (Alderfer & Smith, 1982; Bartunek, 2007; Hogg & Terry, 2000). In particular, intergroup dynamics may arise due to identity group distinctions created by ethnicity, gender, or even by distinctions between roles. Role groups can function as divisive in-groups or stifling hierarchies, and also may focus role occupants on their individual role responsibilities at the expense of the overall deliverable. Therefore, although de-individualized role-based coordination functions well under some conditions, it is likely to fall short when there are salient status differences between roles. In particular, intergroup dynamics in which members of groups other than one's own are seen in negative ways, along with low interpersonal familiarity, may limit the ease of communication and coordination between role groups. In fast-paced, high stakes work environments, where such coordination is necessary for optimal outcomes, even well-defined roles may be inadequate to the challenge.

Team effectiveness research provides another explanation for how individuals coordinate interdependent work. A team is a "collection of individuals who are interdependent… and see themselves and are seen as an intact social entity" (Cohen & Bailey, 1997, pg., 241). The team structures that enable groups of individuals to function as intact, social entities are clear boundaries, membership stability, and interdependence

(Hackman, 2002; Wageman, 2005). These structures set the team up as a stable in-group, which promotes pro-social behaviors within the group (Hogg & Terry, 2000). Stable relationships and familiarity also promote trust and psychological safety, which can ease interpersonal risk and communication challenges (Edmondson, 1999; Harrison, Mohammed, McGrath, Florey, & Vanderstoep, 2003). Having a stable team enables a group of specific individuals to coordinate effectively under non-programmed conditions, because they get to know each other well and are thus able to anticipate each other's moves and adjust to each other's strengths and weaknesses (Hackman, 2002; Wageman, 2005). In these ways, the design and structure of the performing unit is seen as the solution to managing task interdependence. However, this approach is not feasible in settings that require highly flexible or fluid staffing.

Role theory and team effectiveness theory thus focus on different mechanisms enabling coordination. Role theory does not require stable relationships among specific individuals, because role structures dictate task responsibilities. Yet, intergroup dynamics and limited familiarity can impede the communication between role groups with status differences (Nembhard & Edmondson, 2006). Team effectiveness theory does not require stable role assignments, preferring the flexibility of allowing people to work out the division of responsibilities in real time (Cohen & Bailey, 1997; Van De Ven, Delbecq, & Koenig, 1976). Yet, in contexts where role groups are salient, relying on flexible team members in stable teams to co-determine task allotment may not be feasible. Both models thus provide an incomplete explanation for understanding effective role-based coordination; role theory underemphasizes intergroup dynamics and status differences, and team effectiveness theory assumes stable team membership yet flexible roles.

I consider a hybrid approach to the problem of coordination in fast-paced flexible work environments. Instead of groups with stable membership, I consider the value and function of *team scaffolds* – minimal team structures that explicitly bound a small group of roles and give them group-level ownership over their shared work. Such a structure embodies the logics of both role-based coordination and team effectiveness theories. Because team scaffolds bound a group of *roles* (rather than bounding specific *individuals*, as in stable teams (Cohen & Bailey, 1997; Hackman, 1987)), they can be de-individualized. Thus team members who are relative strangers can successfully fulfill their respective roles in the absence of pre-existing or stable relationships. Yet, team scaffolds provide more structure than coordination driven strictly by individual roles by explicitly bounding a group of roles and giving them group-level ownership of shared work. The idea of team scaffolds, along with their potential impact on coordination, has not previously been conceptualized, presenting an opportunity for the research literature on role-based coordination to be advanced (Golden-Biddle & Locke, 2006).

Theorizing Effects of Team Scaffolds on Coordination

Next, I theorize why team scaffolds can materially improve coordination effectiveness and performance among temporary or fluid groups of people. Team effectiveness theory suggests that a small bounded work unit composed of specific individuals will be able to coordinate in non-programmed conditions (Cohen & Bailey, 1997; Van De Ven et al., 1976; Wageman, 2005). I argue that bounding a small group of roles in a team scaffold will produce positive consequences for role-based coordination by improving the social experience of working in the absence of interpersonal familiarity. Specifically, even though roles encode responsibility and interdependence, some unscripted interaction is required to carry out shared work, and it is these interactions that can be made interpersonally safer, mechanically easier, and therefore more effective, by a team scaffold.

The interactions that comprise effective coordination vary across different contexts, but may include sharing crucial knowledge quickly, asking questions clearly and frequently, seeking and offering help, and making small mutual adjustments through which different skills and knowledge are combined (Bechky, 2006; Edmondson, 2012; Faraj & Xiao, 2006). These kinds of interactions are essential for effective interdependent functioning but are also discretionary and may be perceived as extra-role or as interpersonally risky (Edmondson, 1999; Morrison, 1994). The prevalence and efficacy of these interactions depend largely on the social and contextual cues that tell people whether the interactions are safe, desirable, and personally or organizationally valuable. A team scaffold that bounds a group of roles may make these interactions more effective in at least two ways: they become easier because of the benefits of a small group size, and they become safer through the establishment of a shared minimal in-group.

First, a team scaffold creates a temporary small bounded group within a larger organization or work unit. When a work group is smaller, individual effort is more easily identified (Harkins and Szymanski, 1989; Wagner, 1995), which may lead to more proactive communication and coordination because the small group can monitor and influence each other's efforts (Kidwell and Bennett, 1993; Williams and Karau, 1991). A team scaffold can simplify the question of whom to work with, on what, and possibly where. In the absence of this organizing structure, people must work out each of these details themselves, which can result in not knowing to whom their comments or questions should be addressed, not knowing the relative importance of their comment or question relative to their collaborators' other work, and not necessarily knowing where and how to find and address one another. Each of these details – who, what, and how – can be signaled with the imposition of a team scaffold that clarifies the targets of communication and the status of their interdependencies within a small group. The team scaffold thus improves the ability of people to find each other and to know what needs to be done to manage, prioritize, and accomplish their shared tasks.

Second, a team scaffold can function as a shared in-group, which may establish a superordinate group identity, despite the lack of stability of role occupants (Tajfel, Billig, Bundy, & Flament, 1971). In organizational work, people hold multiple identities (e.g., gender, race, profession) that become more or less salient under certain conditions (Alderfer & Smith, 1982; Hogg & Terry, 2000). In stable teams, team membership provides a superordinate identity that can reduce the social distance between people. For example, being a member of Team A may be more salient to a nurse than any of his other social identities during his work shift. Without this team affiliation, he may be self-conscious about his role or status as a nurse in relation to the doctors. Although role identities are still present, they can become less salient when a shared in-group affiliation, like being part of a team, provides a counterbalancing identity (Hogg & Terry, 2000). I draw from this phenomenon to argue that temporary occupancy of a team scaffold can be salient enough to create a positive and shared in-group identity that improves coordination and performance.

The above argument is contingent on people finding the highly temporary group affiliation of a team scaffold meaningful. Because of the high personnel flux that an team scaffold is designed to accommodate, the group-level effects I am theorizing may not exist. Conversely, the minimal group paradigm research shows the minimal conditions required for discrimination and demonstrates that people readily affiliate with an assigned group, even one that is minimally defined (Tajfel, 1982). Affiliation with a team scaffold – even temporarily – therefore may well result in acceptance of and identification with others in the group for the duration of the briefly shared affiliation. In this way, even though a team scaffold contains a de-individualized mix of people, the people in the structure at any one time – even if they start as strangers – may engage in more effective coordination than people who are not delineated as a set in this way.

Hypothesis 1: Team scaffolds will improve role-based coordination and performance compared to unbounded role-based coordination.

Mapping Arguments to Network Methods

In this section I connect the above argument to research on networks, because network methods are a promising approach for studying the fluid personnel or complex staffing patterns associated with our phenomenon of interest. I consider, therefore, what network theory suggests about unbounded role-based coordination compared with team scaffolds. In unbounded role-based coordination, people have to work out in real-time who they are working with, and how many people they are working with. In team scaffolds, these issues are pre-programmed. Network theory suggests that when people have to work out how many people they are working with and who they are working with, these choices may not be optimal, although there are specific ways in which this flexibility is beneficial.

First, prior research in network theory suggests that how *many* partners someone chooses to work with in fluid collaborations is largely determined by task demands – though working out the optimal team size based on task demands is something that evolves over decades (Guimera, Uzzi, Spiro, & Amaral, 2005). It is unclear how optimal group size is established or worked out in fast-paced collaborations that last for hours or days, rather than years. In longer-lasting collaborations, needed expertise and skill sets can be optimized for each task, and this process is what influences team size (e.g., teams creating Broadway musicals evolved to include around seven people to represent all required skills (Guimera et al., 2005)). In tasks that are executed in very short time frames, it can be difficult for people to figure out and manage the right number of collaborative partners in real-time. In unbounded role-based coordination, this number may be restrictively small or unmanageably large, depending on the work context. Alternatively, with a team scaffold, a boundary designates a group of interdependent partners, which pre-programs group size and belonging.

Second, prior network research suggests that people do not find or select their collaborative partners based solely on optimizing performance or efficiency. Finding a new partner or selecting a known partner for an interdependent task is known as tie formation or tie activation (Casciaro & Lobo, 2008). A tie can be formed based on proximity (Kossinets & Watts, 2009), rapidly made judgments of perceived warmth or competence of one's partner (Casciaro & Lobo, 2008), or resource needs and the availability of alternative partners (Katila, Rosenberger, & Eisenhardt, 2008). Although choosing a partner for an episode of interdependent work is only a temporary tie, unlike ties typically studied in network research, the finding that people do not choose partners based solely on optimizing efficiency is relevant. Research shows that partner selection is affected by physical proximity, familiarity, and how easy it is to determine who is available among a large group of possible partners (Allen & Sloan, 1970; Casciaro & Lobo, 2008). Therefore, unbounded role-based coordination – wherein people have to work out their interdependent partners for each task – may not be easy or optimal, particularly in the fast-paced and hyper-fluid work settings that rely on role-based coordination.

Hypothesis 2: Team scaffolds reduce the number of coordinating partners for each focal role occupant compared with unbounded role-based coordination.

Hypothesis 3: The number of coordinating partners will partially mediate the relationship between team scaffolds and improved performance (H1).

Theorizing Effects of Variation in Design and Process

The above argument theorizes how coordination may unfold in an unbounded role-based structure compared to a team scaffold. In this section, I theorize how differences in team scaffold design are likely to influence coordination behavior of the temporary team members. Previous research has demonstrated that work teams vary in the degree to which they have stable membership and are truly bounded and interdependent, and that these design variations influence team processes and performance (Wageman, 2005). Building on this research, I argue that the integrity and performance of team scaffolds might be especially sensitive to variation in structural design because team scaffolds are employed in work settings where temporary team members are not likely to have strong existing relationships and are likely to have strong role identities.

The definitional team scaffold design (as conceptualized in the previous section) is to enact a boundary around small group of roles and assign group-level ownership over shared work. This design functions to help people identify work partners even if they are relative strangers and also to make them jointly accountable for a whole team task. Structural design differences that diminish or undermine either of these purposes are likely to influence how people make sense of their mutual belonging in the team scaffold and how they interact within them.

Boundary

First, there may be differences in how a team scaffold boundary is enacted. In the social sciences, boundaries are understood to be "distinctions made by social actors to categorize people, time, and space" (Lamont & Molnar, 2002). Team boundaries, in particular, are the means whereby it is made explicitly clear who is on the team and who is not on the team (Hackman, 2002). Team boundaries are thus part of the integral (though often implicit) design of a stable work team, defined as a collection of individuals who "see themselves and are seen by others as an intact social entity" (Cohen & Bailey, 1997, pg. 241). There are two main reasons why team boundaries are critical for team integrity and team functioning. In the absence of true boundedness, team members do not know to whom they are accountable, or who they can rely on. Instead, "they cannot reliably distinguish between the people who share responsibility and accountabiltiy for the collective outcome and others who may help out in various ways but are not team members (Hackman, 2002, pg. 44). Also, teams that do not have truly bounded membership may "become totally caught up in their environmental turbulence and lose a consistent sense of their own identity and coherence" (Alderfer, 1980, pg. 269) When teams do not know who they are and cannot maintain their identity as a team in the midst of environmental turbluence, it is impossible to develop a coherent strategy for carrying out a piece of work.

This previous research makes it clear that team boundaries are important for team functioning. What is less clear is how that social boundary is enacted in work teams. This lack of explicit definition about what bounds a team may be due to the nature of stable, bounded work teams, whose boundaries may be signalled in many mutually reinforcing ways like rosters, a strong launch, shared meetings, shared email lists, etc. For stable work teams, stability itself may serve as a bounding mechanism – as the same group of people show up for the team meetings day after day, it becomes clear who the team is. Team scaffolds, on the other hand, cannot rely on stability, and cannot rely on various subtle mechanisms to signal and reinforce team boundedness over time. Instead, team scaffold boundaries should serve to make it explicitly and immediately clear who is part of the minimal team at any time. The distinction may be enacted in various ways, including uniforms or co-location in a physically bounded space. There is limited formal research into the question of how minimal team boundaries are enacted, and the strengths and weaknesses of the various designs.

To the extent that the minimal team boundary is not effective in designating a collection of individuals as a meaningful – though temporary – social entity, the challenges of de-individualized role-based coordination may remain. Role occupants may experience confusion about who is working together and who is accountable to each other. A meaningful minimal team boundary can make it easier to discern who belongs inside the boundary and who belongs outside the boundary, which will make it logistically easier for team members to identify each other. And, it may increase the salience of the minimal team affinity. Belonging to the team might be experienced and enacted as a social reality, and not just a meaningless designation (Hogg & Terry, 2000).

Group-level ownership

Second, the way that group-level ownership is enacted in a team scaffold may vary. Previous research on stable work teams has demonstrated that having a "whole team task" and real group interdependence is critical for team functioning (Hackman, 2002; Wageman, 1995). There are two main reasons why assigning group-level work and group-level responsibility to a team are important. The first reason is because mixed signals about ownership and responsibility are confusing and undermining to team process. Mixed signals arise "when the rhetoric of teams is used, but the work really is performed by indiviudals, or when indivduals are directly supervised but the work is really about the team's responsibility" (Hackman, 2002, pg. 43). Wageman (1995) provides a vivid example of the consequences of how work is assigned to either groups or individuals. She conducted a study of individual, group, and hybrid task and outcome interdependence and found that mixed signals result in confusion and ineffective processes because people "see their rewards as dependent neither on individual performance or group performance" (pg. 175). In contrast, assigning group tasks and outcomes to intact teams resulted in "high-quality social processes, extensive mutual learning, and a sense of collective responsibility" (pg. 174). Wageman argues that teams that were designed with true group interdependence had to develop constructive ways of interacting to survive as teams. She quotes one of her interviewees as saying, “There’s no ‘mine’ and ‘yours’ for us. We go where we’re needed, and we take care of each other” (pg. 174), and notes that this sense of group entitativity did not emerge for people with individual or hybrid work responsibility.

The second main reason that group-level ownership of work is important is because it can be motivating and energizing. Alderfer (1976) analyzed changes between individual and group level responsibility for work that resulted from changing technology in coal-mining. At first, miners were organized into small interdependent groups that shared full responsibility for common territory on shifts. New technology shifted work responsibility to individual miners: they began to function as “individuals with narrowly defined roles specifying the work to be done on each shift,” but this resulted in “a high degree of destructive competition between men in different roles,” undermining the promise of the new technology (pg. 120). Finally, a new social organization emerged in the mines, with larger groups taking responsibility for shared work. Within these larger groups miners took on interchangeable roles on different days. The miners had better relationships, reported more satisfaction, and the system operated at a much higher level of efficiency than when the work was assigned to individual miners. Group belonging and responsibility for a team task allows team members to help and support each other, and also to monitor each other and hold each other accountable for actions.

This previous research demonstrates the importance of group-level ownership of work in stable work teams. There is limited research on group-level ownership in team scaffolds. It seems likely that this design feature is particularly important for minimal team functioning. Team scaffolds are employed in work settings organized around roles, where tasks are typically subdivided into individual role responsibilities. There may be significant mismatch between how people experience their individual responsibilities and the groups' responsibility for work. People may be focused on their individual work responsibilities at the expense of the overall group deliverable. Mixed messages (like monitoring or rating individuals on work that requires multiple people to accomplish) may result in confusion and conflict between roles, which may undermine how people coordinate their work.

Assigning a group of roles group-level ownership can align individuals' efforts and attention with their shared deliverable. Group-level ownership of work can allow for mutual prioritizing, negotiating, and executing activities. In short – assigning work to a team, rather than to individuals or co-acting groups, allows "for the benefits of teamwork" (Hackman, 2002, pg. 42). However, as there may be significant differences in how group-level ownership is designed and enacted, this is a question for further research.

Research Question: What are the various ways that team scaffolds are designed and enacted in fast-paced, flexible work settings, and what are the consequences for how people coordinate?

Mapping Arguments to Pod Performance

The theory above focuses on how team scaffolds compare with unbounded role-based coordination and differences in team scaffold design. The final analysis in my dissertation was intended to be an examination of team scaffold performance. However, in the empirical setting that I used to develop and test my ideas, there was substantial variation in how the team scaffolds were designed and implemented, to the extent that in one of my field sites, meaningful minimal teams were not successfully set up. Because of these empirical realities, a test of team scaffold performance would not be conceptually correct. Instead, I compare the performance of the work unit that is consistent across my field sites, which is an emergency department (ED) pod. These are described in thorough detail in the methods section. For the purpose of building an argument about factors likely to influence pod performance, I define pods as self-contained ED work units that are staffed by role structures comprised of physicians, nurses, residents, physicians assistants (PAs), and ED technicians ("techs"). People occupying these different roles coordinate to provide emergency medical care to patients who seek care at the ED. The main purpose of the ED setting is to stabilize patients and route them to the appropriate care setting, so the focus tends to be on efficient (but high-quality) operational throughput of patients.

Previous research on coordination in de-individualized role structures (like the ED pods) has been mainly qualitative or ethnographic (e.g., Bechky, 2006; Bigley & Roberts, 2001; Faraj & Xiao, 2006; Klein et al., 2006), so little is known about the objective performance of work units organized around role structures. Some studies in health services research have identified factors associated with better performance in large medical wards or units (e.g., Shortell, Rousseau, Gillies, Devers, & Simons, 1991), which presumably design work around role structures, but these studies tend to aggregate work unit performance over time, without paying attention to the fluid staffing patterns within the work unit.

Fluid staffing patterns create varying levels of experience among the people staffing work units at any time (Huckman, Staats, & Upton, 2009). People may have accumulated extensive experience working together over time on various tasks or shifts, or may be working together for the first time. The relationship between accumulated experience working together and performance has been considered for stable and fluid teams (e.g., Huckman & Staats, 2011; Reagans, Argote, & Brooks, 2005), but less is known about the role of accumulated experience in de-individualized role-based coordination. Because role structures are designed to be robust to variation in personnel, including how much personal experience a role occupant has, and how much interpersonal experience a group of role occupants have working together, it is plausible that interpersonal familiarity does not predict performance in role-based coordination. On the other hand, many of the benefits of working together identified for stable or fluid work teams may also operate in role-based coordination. Huckman et al. (2009) identify two mechanisms through which experience positively influences performance: coordination and willingness to engage in a relationship. Experience working together improves coordination because people have practice working together and can develop a shared language and shared understanding of their work together (Moreland, Argote, & Krishnan, 1998; Reagans et al., 2005; Teece, 1981). Willingness to engage in a relationship in role-based coordination may relate to willingness to begin or sustain a discussion about shared work, which may be less likely to happen in the absence of trust or familiarity. Better coordination and more willingness to engage in interactions should both improve the performance of pod role structures.

Hypothesis 4: Group familiarity (i.e., accumulated experience working together or lifetime weight of ties) is associated with better pod performance.

The previous argument relates to experience accumulated between role occupants over time. Because of the nature of work in pod role structures, people can also accumulate experience working together within a given shift by working together on many patients during that shift. The mechanisms that link within-shift experience and performance are likely different than the mechanisms identified above as linking lifetime experience and performance. Working together on many patients during a shift may allow role occupants to multi-task and parallel process several patients at the same time, rather than engaging in a sequential work flow (Van De Ven et al., 1976). People may also avoid the start-up costs of a new coordination partner, like identifying and finding each other, and learning how to work together. On each subsequent task, coordination costs will be less, making work more efficient.

Hypothesis 5: Shared patients (i.e., within shift weight of ties) is associated with better pod performance.

In summary, experience accumulated both overtime and within a shift are likely to improve the performance of the ED pod work units.

Dissertation Overview

In chapter one of this dissertation, I developed arguments related to role-based coordination, team effectiveness, and minimal team structures. The formal hypotheses and research questions associated with these arguments are reported in Table 1. In chapter two, I describe the research strategy and empirical setting that I employ to develop and test the arguments presented in chapter one. I describe the emergency department research context, my three field sites, and the qualitative and quantitative analyses I implement to develop theory and understanding about team scaffold design and ED pod performance. Chapter three reports an in-depth analysis of one ED that changed from unbounded role-based coordination to team scaffolds. Chapter four reports a cross-case comparison of the team scaffold design at three EDs that attempted to implement team structures in their pods. Chapter five reports a cross-site analysis of pod performance. In chapter six, I discuss the implications of my findings and results for theory and practice.

Table 1. Formal hypotheses and research questions

Hypothesis or research question	Location of empirical analysis within dissertation
Hypothesis 1: Team scaffolds will improve role-based coordination and performance compared to unbounded role-based coordination.	Chapter 3, quantitative analysis
Hypothesis 2: Team scaffolds reduce the number of coordinating partners for each focal role occupant compared with unbounded role-based coordination.	Chapter 3, quantitative analysis
Hypothesis 3: The number of coordinating partners will partially mediate the relationship between team scaffolds and improved performance (H1).	Chapter 3, quantitative analysis
How do team scaffolds affect the social experience of role-based coordination?	Chapter 3, qualitative analysis
How are team scaffolds designed and enacted and what are the consequences for how people coordinate?	Chapter 4
Hypothesis 4: Group familiarity (e.g., lifetime weight of ties) is associated with better pod performance.	Chapter 5
Hypothesis 5: Number of shared patients (e.g., shift weight of ties) is associated with better pod performance.	Chapter 5

CHAPTER 2. METHODS

To develop theory and understanding of team scaffolds in the fast-paced, flexible work environments that rely on role-based coordination, I implemented three main analyses which I describe in this chapter: 1) an in-depth multi-method case study of one organization that implmented team scaffolds, 2) a qualitative cross-case comparison of team scaffold design, and 3) a quantiative analysis of pod performance.

Research Context

I studied team scaffolds in the context of hospital emergency departments (EDs). Hospital EDs are an appropriate research context because their core work activities require the coordination of effort and expertise between people with diverse skills and responsibilities, but work is typically accomplished by extremely fluid groups of people. EDs are typically open 24/7 and have multiple, staggered shifts, meaning the composition of individuals who are staffing the ED varies significantly even within a single shift. At the time I began my dissertation, EDs were said to be "in crisis" and many changes were being implemented that changed the way that work in the ED was coordinated and organized (Mason, 2007). I leveraged these changes to explore and analyze how organizations can support effective coordination between people who are only working together temporarily, as in the ED.

The ED crisis stemmed from two main factors: high volumes and ineffective teamwork. Most EDs in the United States were operating at or over capacity (Adams & Biros, 2001; AHA, 2002; Derlet, Richards, & Kravitz, 2001). High ED volumes were driven by increases in the number of uninsured patients who had poor or no access to primary care, nursing shortages, hospital closures, and demographic trends in the US population (because the elderly are more likely to require and seek ED visits) (McCaig & Ly, 2002; Shute & Marcus, 2001). Overcrowding was problematic for patient safety: more than half of the reported cases of patient death or permanent disability due to treatment delays occurred in the ED (JCAHO, 2002).

Ineffective teamwork was a serious problem in many health care settings, including EDs, where the high volumes and life-or-death situations meant teamwork in the ED was particularly high-pressure and high-stakes. Several factors contributed to ineffective teamwork in this setting (IOM, 2001). EDs operated 24/7 with multiple, staggered shifts, such that the group of people staffing the ED constantly changed, making coordination and teamwork complicated. Also, status differences between medical role groups inhibited teamwork because both high- and low-status role occupants avoided open conversation for fear of embarrassment or disrupting the hierarchy (Edmondson, 1996; Nembhard & Edmondson, 2006). These challenges also mattered for patient outcomes: in a review of 54 malpractice incidents in an emergency department, eight out of 12 deaths and five out of eight permanent impairments were judged to be preventable if appropriate teamwork had occurred (Risser et al., 1999). Errors were often the result of missing information from poor nurse-doctor communication rather than misjudgment (Siegal, 2010).

These and other challenges prompted many EDs to adopt process improvements or large-scale process redesigns. For example, some EDs changed their triage systems to include fast-tracks or rapid-disposition units (Ben-Tovim et al., 2008; Spaite et al., 2002). Others, like the hospitals that I studied, implemented a redesign that involved dividing an ED into smaller sections, sometimes called pods. Pod design varied by ED, but typically pods were subdivided sections of an ED, each staffed and equipped with the personnel and equipment necessary to treat any type of ED patient. The pod redesign was intended to control the scale of the department by dividing patients and staff into sub-groupings. Some EDs also attempted to organize some type of team structure within their new pods with the hope of supporting more effective teamwork.

Research Design

Multimethod case study of one ED's redesign For the first analysis, I pursued an in-depth study of one hospital over time ("City" Hospital). I implemented a single site research design for this analysis for two reasons. First, my research aim was to compare two ways of structuring coordination between fluid groups of people: unbounded, role-based coordination and coordination in team scaffolds. City Hospital ED implemented a department-wide, time-limited discrete intervention to change between these two work designs. The City Hospital ED redesign was accomplished with low cost, only minor additions of physical space for the department, and with minimal staff changes or changes in patient population. This allowed for a relatively pure comparison of the coordination structures before and after the redesign because little else changed in the department at the time of the intervention. I began with this analysis, rather than a multi-site comparison, to develop deep understanding of how team scaffolds function, before attempting to explain possible variation across sites.

Second, an in-depth study of a single organization is consistent with current practices in theory building using case studies (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). According to Eisenhardt and Graebner (2007), it is appropriate to use a single case if the study focuses on a phenomenon-driven research question. This analysis builds on theories that explore temporary and fluid collaboration, but the focus is on the new phenomenon of using team scaffolds to support such collaborations. These kinds of structures have not been deeply conceptualized in the research literature. I argue that an in-depth look comparing unbounded role-based coordination with team scaffolds at City Hospital can provide what Siggelkow (2007) calls a "very powerful example" from a single organization (pg. 20). I was able to collect qualitative and quantitative data, leveraging the strength of each and thereby providing triangulated insights from a single site over time. The quantitative data reveal quantifiable changes in how and how well people coordinated in the two different work designs, and the qualitative data illuminate the different social experiences. I thus report a rigorous analysis comparing the social processes and objective outcomes of two different work designs enacted within the same department by more or less the same group of people.

Qualitative cross-case comparison of three ED's redesigns

Although the results of the multi-method single case study – like the one described above – can provide deep insight and evidence about structures and processes at one organization, these results may not generalize to other organizations or settings. To develop a fuller understanding of team scaffolds in role-based coordiantion, I also implemented a multi-site study to develop theory through comparative case analysis (Eisenhardt, 1989). The first analysis described above compares unbounded role-based coordination with team scaffolds, and the focus of this second analysis is on developing a fuller understanding of variation in team scaffold design across organizations. The preliminary research question motivating this inductive cross-case analysis was "what are the design differences between minimal team structures, and how do those design differences influence coordination?" This question relates to existing literature that shows that work team design varies with important consequences for team processes (Hackman, 2002) and that structures influence coordiantion behaviors (Okhuysen & Bechky, 2009), but it should be understood as a nascent question because it is "an open-ended inquiry about a phenomenon of interest" (Edmondson & McManus, 2007, pg. 1160). Because this study is motivated by a nascent research question, it appropriately implements an inductive research approach using qualitative open-ended data that must be interpreted for pattern identification (Edmondson & McManus, 2007; Eisenhardt, 1989). The contribution should therefore be interpreted as "a suggestive theory, often an invitation for further work on the issue or set of issues opened up by the study" (Edmondson & McManus, 2007, pg. 1160). The strength of a cross-case comparative approach is the "likelihood of generating novel theory, because creative insight often arises from the juxtaposition of contradictory or paradoxical evidence" (Eisenhardt, 1989, pg. 546). The result is also likely to have strong empirical validity because it is so closely tied to varied research contexts.

Quantitative analysis of pod performance

In the third and final analysis of this dissertaion, I focus on the objective performance of the pod structures implemented at three hospitals. Some of this analysis was informed by insights developed in the qualitative cross-case work – mainly around pod lay-out and staffing practices – but the emphasis was on testing relationships between variables known to influence coordination among fluid groups in other settings. A quantitative analysis broadens the evidence-base for pod and team scaffold effectiveness, and also leverages the strengths of objective archival data (i.e., these data are not subject to response bias, recall bias, and social desirability biases (Fisher, 1993; Paulhus, 1991; Stasser & Titus, 1985)). This final study therefore provides important analyses and evidence for understanding performance of various structures in role-based coordination.

Site Selection

As preparation for this dissertation, I interviewed leaders and staff at seven EDs about their work processes and redesigns (either proposed or realized), and visited five EDs in person. During these visits and interviews, I learned about the typical work flow and role responsibilities of nurses, physicians, and ED techs. I observed similarities across the EDs, mostly around the division of labor between nurses and physicians, and the general flow of patients through the department. I also read supplementary materials, like physician memoirs or operations manuals, to further our understanding of work in the ED (Crane & Noon, 2011; Engrav, 2011; Lesslie, 2008).

These background materials helped in site selection. Selection of research cases (sites in these studies) is a crucial part of building theory from case studies (Eisenhardt, 1989). The first site was selected somewhat serenipitously, before I understood the exact nature of their redesign, and its implications for theory and research. Selecting cases for the cross-case comparison was more theory driven, because I better understood the phenomenon and possible sources of extraneous variation. In selecting additional cases for comparison, I was informed by considerations of the referent population against which my first site should be compared (Eisenhardt, 1989). I could have selected a different work setting organized around role-based coordination (e.g., airline crews) to explore findings that generalized beyond industry. I might have also selected EDs that had very different patient populations, staff, scale, or setting (e.g., rural vs. urban) to explore findings that generalized beyond large, urban, teaching hospitals. Instead I chose to study EDs at hospitals that looked as similar to my first setting as possible, because I my research focus was team scaffold design and I wanted to control extraneous variation from every other source other than pod design. Ultimately, I found cross-hospital differences in the power dynamics between physicians and nurses that influenced how the team scaffolds were designed (that somewhat limited my ability to draw generalizations about exact design and coordiantion processes), but this is an example of an unexpected finding that resulted from controlled variation, not extraneous variation.

The three hospital EDs that I selected

- Were teaching hospitals. This characteristic was important because of the way the presence of resident physicians in the ED influences intergroup and power dynamics between physicians and nurses (Bartunek, 2011), and because of the tension between resident education and patient care, both of which are likely affected by redesigning work flow
- Were urban, safety-net EDs. Urban, safety-net hospitals serve high volumes of indigent patients and therefore provide a considerable amount of unpaid care, the majority of which is initiated in the ED (Clark, Singer, Kane, & Valentine, 2012). This was an important characteristic because serving indigent, uninsured patients often requires different skills and resources that might influence how

pods are designed and staff. I wanted to identify design differences that were not reflective of different patient populations.

- Were trauma one centers. Similarly, EDs that are accredited and prepared to treat the most acute trauma cases are laid-out, staffed, and equipped differently (Southard, 1994), so I did not want differences in pod design to reflect different operational mission and scope.
- Planned to implement or had implemented a pod redesign, with the intention that the pods would serve any ED patient, regardless of acuity, arrival mode, or diagnosis. Some EDs implemented redesigns that were focused on treating certain types of patients in certain areas of the ED (Spaite et al., 2002). Even if an ED referred to their work structure as a "pod system" but triaged patients to separate areas of the ED, they were excluded from consideration to reduce extraneous design variation.
- Had an electronic medical record (EMR) system. This was an important characteristic in part because I relied on the EMR as a source of data, but more importantly, EMRs significantly influence how physicians and nurses coordinate (Feufel, Robinson, & Shalin, 2011; O'Malley, Grossman, Cohen, Kemper, & Pham, 2010), so I needed to select three EDs that were organized around EMR-supported work flows.

Research Sites

Three EDs matched on teaching mission, patient population, and scope of services were selected as research sites. Each ED, redesign, and change processes is described in Tables 2a-2c below.

Table 2a. City Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

Background	City Hospital is located in an urban metropolis in the southern United States. It is an academic teaching hospital and home to around 8,000 employees, 1,300 attending physicians, 2,300 nurses, and 1,200 residents and fellows. The main hospital treats one of the largest and most diverse groups of patients in the metropolis area. City is a safety-net hospital and serves indigent patients and therefore provides a considerable amount of unpaid care. Like many hospitals, the majority of City's unpaid care initiates in the ED. The City Hospital ED treats high volumes of patients and is one of the busiest in the country. Almost 200,000 patients were treated in 2010. It is also home to one of the largest Emergency Medicine Residency training programs for physicians. Historically, the main ED at City Hospital was divided into two separate treatment areas, labeled "surgery" and "medicine". Upon initial triage, a patient's presenting complaint was evaluated as being surgical/trauma or medical in nature. An attending surgeon and

Table 2a. (Continued) City Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	surgical residents directed care on the surgical side, and an internal medicine attending and medical residents directed care on the medical side. The most critically ill patients were treated first, and then a designated triage nurse determined the order in which patients saw a physician. This division of labor and methodology of treatment existed for more than 30 years and continued through the 1990's with only two changes. Emergency Medicine faculty began working in the City ED in 1989, and an Emergency Medicine training program started at the university affiliated with City with primary training commencing at City in 1997. Between 2002 and 2005, multiple efforts were made to change internal ED processes, but these were piecemeal and only marginally improved throughput times. Beginning in 2005, some collaborative cross-departmental efforts resulted in marginally reduced length of stay, door-to-physician times, and left-without-being-seen (LWOBS) rates. Even so, City's performance remained so poor it was considered an outlier by a national consortium that benchmarks ED performance at academic medical centers, and was removed entirely from the performance database. Improvement efforts were unsuccessful because they did not go far enough in changing deeply

Table 2a. (Continued) City Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	rooted processes or culture. Slight adjustments yielded small improvements that were eventually abandoned or lost because of the overwhelming patient volume and complex work environment.
Designing the New Work System	Two main methods were utilized to design and develop a new system: observation and analysis of existing work flows, and site visits to other EDs that had developed innovative processes. The redesign team, consisting of a dedicated operations manager (who had previously worked as a nurse), the nursing director, assistant nursing director, and medical director oversaw this process. They adopted national benchmarks as the key metrics by which to plan and evaluate the change process. They began with direct observation of patient flow in the emergency department. During this phase, patients were followed through every step of their ED visit. They also observed the various staff members of every department that had influence over the patient's visit, whether direct or indirect. For example, physicians, nurses, and techs were observed during their natural workflows in patient treatment rooms. Lab specimens were tracked through the lab process in order to identify possible time-savings. Using these data, the redesign team mapped all of the patient flows through the ED

Table 2a. (Continued) City Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	(including all patient entry and exit points). This observation, along with staff interviews, provided the data necessary to identify bottlenecks in patient throughput. They also conducted site visits to Detroit Receiving Hospital and the University of Chicago. These sites were identified because of specific processes they had implemented to improve patient flow. Detroit Receiving Hospital was chosen because of its POD implementation (self-contained 12-14 bed ED units), and Chicago was chosen because of its SWAT beds (beds where stable patients are Strategically Worked up, Assessed and Treated and then returned to the waiting room awaiting disposition). Once a general idea of process change was developed, workflows and physical space were again analyzed using Lean and Six Sigma principles to further increase efficiencies. They adopted the theory of the Toyota Production System to eliminate waste. Specifically, they attempted to remove all "Non-Value-Added" steps for the patient: if a step did not add value to the patient experience, or increase safety/quality for the patient, it was eliminated.
The Redesign	*Before the redesign* Patients were triaged and either held in the waiting room or sent

Table 2a. (Continued) City Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	directly to the ED depending on the acuity of their symptoms. Coordination typically unfolded in a series of sequential role-based tasks including taking a medical history, making and carrying out orders, and eventually dispositioning (admitting, discharging, or transferring) the patient. Nurses took a medical history and carried out orders. Resident physicians ("residents," the physicians in training) were responsible for the decision-making about ordering, diagnosing, treating, and dispositioning. The attending physicians ("attendings," the physicians in charge) oversaw this process. Before the redesign, attendings held formal rounds (discussion of each patient's status and care plan) with the residents several times a day. The nurses were not typically included in rounds. The ED was one large department with two main rooms. There were segregated physicians and nurses working stations at opposite ends of the rooms. *After the redesign* Based on what the redesign team observed in Detroit, Chicago and their own ED, they decided to implement a pod system with SWAT beds. The large single Department was divided into four smaller and more manageable "pods". Each of these pods was staffed and stocked identically and able to handle any type of patient. Every pod also had

Table 2a. (Continued) City Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	two SWAT beds to allow for rapid patient evaluation and initiation of treatment. Each pod had the following complement of staff: an attending, a pod lead nurse, two staff nurses, and one or two residents or interns. This staffing model, as well as the increasing volume of patients, required adding additional attendings and nurses. The pods were thus stable structures that persisted over time, but the individuals staffing each pod changed constantly. In fact, within as little as five hours, all of the individuals staffing a pod could change (but not simultaneously) as a result of shift changes staggered across roles. The nurses, residents, and attendings (collectively called "providers") were assigned to a pod at the beginning of each shift. These pod assignments were made more-or-less at random, so that providers typically started in a different pod with every new shift. This meant that "pod mates" varied every shift as well. Resident education happened within the pods following the redesign, rather than through department-wide rounds. Patients were assigned to the pods in a round-robin method: Pod 1 received the first patient, Pod 2, the second etc. Patients were brought directly to their assigned pod. Additionally, triage was reformatted strictly utilizing the ESI triage scoring system. Care was

Table 2a. (Continued) City Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	standardized to decrease variation between pods as much as possible. The information technology (IT) system was used to hardwire standard processes. For instance, a color-coded length of stay alert was created to signal when a patient had stayed beyond a certain time threshold. Performance metrics for each pod were posted in real-time through the IT system.

Table 2b. Metro Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

Background	Metro Hospital is a level I trauma center located in an urban city in the northeastern United States. It was founded in 1980. It is an academic teaching hospital (affiliated with a major research university) and home to around 8,600 employees, 1,300 physicians, and 1,700 nurses. The Metro Hospital ED is a designated receiving center for heart attacks, strokes, and all types of adult illnesses and injuries requiring emergency care. Approximately 25 percent of patients arrive via emergency medicine services (EMS), and many patients are transferred in from other institutions to receive specialty medical or surgical care that few emergency departments in the country are equipped to provide. The ED cares for nearly 60,000

Table 2b. (Continued) Metro Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

Background	patients each year, serving people from throughout the urban and extended area. Metro ED is in an urban area, so also provides charity care to many indigent patients. The ED has a dedicated staff of attending physicians, but shares resident physicians with four other hospitals in the surrounding urban area. The residency program is four-years long (as opposed to the usual three). The nurses at Metro are part of a very active nursing union that was formed in 1978. They are part of the statewide nurses association which was founded in 1903 and has strong collective power.
Designing the New Work System	The first step in the redesign was that the ED was granted more space to expand to match increasing patient volumes. The additional space was seen as helpful but not sufficient to adequately to address the high patient volume, so the management team felt compelled to also redesign processes to see patients more efficiently. The nursing director explained, “If you can’t have more space, you have to see patients more efficiently.” To improve the efficiency of their processes, the nursing director and medical director participated in a Lean Practitioner class sponsored by Metro Hospital which trained managers on the application of Lean principles to their various departments. At the workshop, they analyzed all Non-Value Added

Table 2b. (Continued) Metro Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

Designing the New Work System	(NVA) steps of the patients' flow through the department. Their first focus was on identifying NVA steps in the registration process, thereby reducing door to physician time. Their process redesign was also very focused on information collected from patients through interviews and patient satisfaction surveys. One theme identified in patient satisfaction reports was that patients were frustrated at having to tell "their story" multiple times to multiple providers (i.e., because the nurse, resident, attending all came into the patient room at separate times and asked for the patient's medical history and symptoms). The nursing and medical director focused on eliminating the need for patients to tell their story to multiple providers, and this desire was a main motivator for the "team-based" care that was developed in the ED.
The Redesign	*Before the redesign* The registration process was significantly different. The patient would first check in at the registration desk, but no clinical information would be taken, and the patient would enter the waiting room. Next the patient would be called to see a triage nurse, where clinical information was recorded. The patient would return again to the waiting room. Then the patient would be officially registered, which would take about 10 minutes, and would include extensive

Table 2b. (Continued) Metro Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	documentation of patient demographics and background (e.g., what high school the patient attended). The original reason for registration proceeding this way was the law: the ED was prohibited from asking for insurance information before some sort of acuity screening. After registration, the patient would again return to the waiting room until a nurse in the ED called him back to be seen by a nurse and physicians. The ED was divided into two areas, which were (at least retrospectively) called pods. Each pod was run by a nurse-in-charge (NIC). A major complaint of the management team was that because the ED rooms did not have monitors; as a result, the nurse-in-charge (NIC) would not bring the patient back even when some rooms would be open. The NICs felt their job was to balance the workload of the nurses in his or her area, and that not bringing a patient back was always justified by the situation they were balancing. Each pod area was supposed to take certain types of patients – oncology patients always went to a certain area, and acute patients always went to the main area. The nurses' assignments were geographic, so each nurse had ownership of whatever patients the NIC placed on their beds. Each pod was staffed by typically two attendings and five residents or PAs. The attendings, residents, and PAs could work with any patients in the pods, so were typically working with many different nurses in

Table 2b. (Continued) Metro Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	many different areas at the same time. *After the redesign* There were several pieces to the redesign, including both process changes and structural changes. There was a ribbon cutting ceremony to celebrate the opening of a new pod in the ED. Leading up to that, there were some incremental front-end changes around registration. The concept was that rather than taking the patient through a full triage and registration in the waiting room, there would be a rapid assessment of patients when they walked in the door and assignment to a bed. Also, the patients were supposed to be able to go to any pod, rather than being sorted by acuity or chief complaint. The Metro ED web site says, "Walk-in patients proceed to a check-in desk, where they are greeted by a registered nurse and asked a short series of key questions. Patients are then assigned to a provider team and brought directly into the patient care area instead of back to a waiting area. With the Metro emergency care model, the focus is on getting patients directly to care, and as long as the ED has capacity to accept new patients, a "direct-to-provider" model is employed." This was the intent of the redesign, but it was more complicated in practice, and there was a sense among the triage and staff nurses that this was not safe and was not actually happening in the ED.

Table 2b. (Continued) Metro Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	Also, as part of the official redesign, Metro opened up a third pod (the first two were very different than the third pod in terms of staffing, scope of care, and lay-out, so the label "pod" was applied loosely at this ED). The extra space came from the demolishing the waiting room, the lobby, an old gift shop, and a small OB admitting room. When the third pod was opened, they also started a new process in the other pods organized around the idea of teams. There were two distinct changes that were described as "team-based care," and the nurses and physicians seemed somewhat confused by this. The first change related to "team-based care" was that at the beginning of the day, the staff in the two original pods were divided into teams. Each pod was large enough to accommodate two attending teams, so two attendings would be working in each pod with designated residents or PAs. This was as opposed to sort of residents and attendings matching up in ad-hoc patterns. The nurses were still geographic. The second change labeled "team-based care" was for every member of the team to go into the patient's room at the same time. Note that this "team" would be a subset of the designated teams described above. The medical director described it as the team from the patient's point of view: all of the nurses and physicains who would ever see the patient were the patient's "team." Both of these "team-

Table 2b. (Continued) Metro Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	based" process changes were more complicated in reality than in design. Finally, the redesign included a new staff position: flow managers. Each pod still had a NIC, but another layer of hierarchy was introduced with the flow managers, who were responsible for the flow of the entire department, not just individual pods. The flow managers were nurses, but were hired as part of the management team, and were hired from outside of the nursing union. There was a lot of discussion about the flow managers being redundant to the NICs, and being a tool of the management to try to control the nurses.
Change Process	Construction to add the new pod was somewhat disruptive because it resulted in a temporary net loss of overall space. The construction was meant to be incremental, but at times the construction meant the ED was down as many of six beds, and providing care in the hallway space. The process changes were communicated to the staff through emails, memos, and word of mouth. People were generally unhappy with the level and quality of communication around the change processes. The direct-to-bed registration process was taught to the nurses, but it was not actually used by the nurses, who continued to triage patients in the waiting room.

Table 2b. (Continued) Metro Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	The team process was not well communicated or understood. People would show up to their shift and ask each other, "Are we doing teams today?" and eventually everyone stopped "doing teams." The nurses were strongly opposed to the new registration process and to the introduction of the flow managers. At the time of my interviews, about one year after the redesign, the redesigned processes related to registration and "team-based care" were not being followed. The new pod was still open and was generally liked because it was smaller and supported better communication between nurses and physicians. The flow managers were still part of the department, but the nurses were extremely unhappy about the presence of the flow managers, and the attending physicians did not think they added any value to the department. During this time, there did not seem to be any more focus on change – there seemed to be a wary stand-off between the nurses (who were not doing the registration redesign processes) and the management (who were not actively dealing with that fact).

Table 2c. Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

Background	Urban Hospital is located in New York City. The hospital staffs around 850 doctors and dentists, 1600 nurses and more than 350 house officers and 85 fellows. They serve a spectrum of patients, ranging from the homeless uninsured to the privately insured patients who travel to Urban for the specific care provided there. The hospital treats more than 110,000 patients a year in its Emergency Department, making this one of the busiest Emergency Departments in NYC. The hospital renovated its facility in 2010, which included the construction of a new physical space, in addition to workflow changes and enhancements to staffing to optimize teamwork and continuity of care. The hospital specializes in treating patients of stroke, heart attack, broken bones, acute asthma and psychiatric emergencies. The current medical director of the ED began in 1996. He described departmental priorities as first, the eduation of resident physicians, and second, serving the community by providing emergency medical care. The ED had been redesigned or expanded about six times since 1980. These changes were typically motivated by the need for more space to accommodate increasing patient volume. The sense among the leadership was that as soon as one expansion plan was complete, they would have to develop a new plan to make even more

Table 2c. (Continued) Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

Background	space. For example, the ED was completely rebuilt in 1991, and as soon as 1997, the leadership team had to appropriate what had been administrative space and repurpose it for an urgent care center. Soon after, they expanded even more by moving the pediatric area to another location and repurposing the old pediatric area for a fast-track area. Over time, the ED was constantly reinventing itself. Change was seen as a good thing, and there were many changes in the physical space and also in the staffing model. Each role group was brought into and out of different areas of the ED (main, urgent, fast-track) in attempts to find an optimal staffing configuration for each area.
Designing the New Work System	A physician assistant (PA) manager who had worked at Urban Hospital ED since 1980 (first clinically and then in management) was in charge of redesigning the ED. She had been instrumental in previous redesigns and was familiar with the staffing and lay-out of the ED. The most difficult piece of the redesign was that the ED needed more space, but was located in a downtown urban environment, so it was almost impossible to expand the ED footprint. Architectural consultants were brought in and suggested solutions like moving the ED to another building or operating across two floors.

Table 2c. (Continued) Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	Ultimately, a plan was adopted to destroy a historical auditorium and move the loading dock, which gave the ED the additional space it needed to expand on the same floor. The redesign immediately before the pod redesign had included setting up an urgent care unit called the "Northwest" unit (because insurance would provide lower reimbursements for care given in an area called urgent care, even if it was in an ED). The "Northwest" area was the inspiration for the pod system at Urban Hospital. More than 30% of the entire volume of the ED was seen each day in the small Northwest area, meaning Northwest was more efficient with a smaller group of people than the larger ED areas with more staff members. Soon the triage system began sending more acute patients (not just urgent care patients) to Northwest because of these efficiencies. The redesign manager said that she observed tremendous efficiency from having a small group of people working together and from everybody working in the same little area. She said, "The Attending was right there. If you needed the Attending, you didn't have to go looking for them. They were sitting right there. The nurses were right there. Everybody knew what was going on." Turnover happened as a team, and discussion of interesting patient cases happened as a team. She explained, "You were just in this small

Table 2c. (Continued) Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	area, so everybody heard what was going on. The nurses always knew things the doctors didn't know." This efficient team size and structure emerged somewhat by chance in the Northwest unit and provided the motivation for the pod system that Urban Hospital ultimately adopted. The nurse manager also visited several other EDs during the process of the redesign and saw that many of them were "spread out and enormous," and she felt that the "accountability and the close working situation was not there" in such designs. The redesign was intended to create many pods like the Northwest unit that could handle any acuity of patient.
The Redesign	*Before the pod redesign* The ED was organized into a Main ED area, the Northwest unit, a fast-track section, and a pediatrics unit. The Main ED was a large room with patients on the periphery of the room. There were rooms dedicated to certain kinds of patients (like an ambulance triage room, a gynecology room, a resuscitation room, and three other patient care zones). There was poor visibility from one end of the room to the other because there were support beams and floor to ceiling structures in the middle of the room. There were bar-height counters in the middle of the rooms and the nurses had stools against them (with their backs to the patients). The physicians had one small centrally located

Table 2c. (Continued) Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	area that they would "cram into." The ED at this point was very cramped, there were curtains separating stretchers, with barely any additional room inside the curtains for physicians and nurses to be in the area together. At first the physicians were geographically based (i.e., responsible for certain beds) but this resulted in imbalances because certain beds always had more acute patients. This was changed, and before the redesign the physicians were supposed to be organized into teams instead of geographically based. The teams were based on the attendings – there was an Attending A team and an Attending B team, and the Attending had residents or PAs assigned to them. Patients were distributed round robin between the attendings, which was supposed to help the attendings be efficient, although it meant that an attending might have a patient in room 1 and room 12 at the other end of the main ED. The nurses were geographically based (i.e., when they begin a shift they were assigned to a region of beds that they were responsible for their entire shift), but this was a source of debate for many years. The nurses wanted their own dedicated beds to be responsible for, and they did not want what was described as a "team approach where you get every other patient" because the concern was that a nurse might have

Table 2c. (Continued) Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	also have patients at opposite ends of the room. Transitions between attending physicians would typically involve rounding on patients for the entire ED. The nurses did not participate in rounds because they were staying with their patients (and also only a fraction of the discussion would be relevant to their patients). *After the pod redesign* The ED space was transformed during the redesign. The ED was organized into three pods that were meant to be relatively similar in lay-out and staffing and that could all see high acuity patients. The idea of the pod system, originally, was that the ED could go from a small village (during times of low volume) by only having one pod open to a big city (during times of high volume) by having three pods open, yet still maintain the feeling of the small village. The pods were separate rooms, separated by hallways. The rooms were square or rectangle and were designed with patient rooms all around the periphery of the room. A chest-high counter sectioned off a square or rectangle in the middle of the room. The nurses sat on high stools (with no backs) and used computers on the outside of the counter. The physicians and PAs sat on office chairs and used computers placed on the low counters inside of the pod counter. A sign in each pod listed who were the physicians in the pod that day. There was no

Table 2c. (Continued) Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	signage indicating who were the nurses in the pod that day. Each pod had a color scheme (blue, green, and orange) and all of the signage and paperwork associated with the pod was in that color. At the time of the redesign, the management team thought that only the blue pod would stay open overnight based on the volume they were seeing. After a neighboring hospital closed, they had to adapt by keeping two (blue and green) pods open overnight. In each pod, there was only one attending, and a set group of nurses and residents or PAs. Every pod was supposed to see every patient acuity-level. Patients were placed in certain beds within certain pods by a Patient Care Coordinator (PCC). The goal was for the PCC to assign patients in a round-robin fashion, but that was not realized in practice. The sense was that the assignment of patients went to attendings, based on their pod. Residents and PAs self-assigned to the patients, and nurses were geographic. Turnover happened within role groups. The original pod design changed during implementation and the few months following in two ways. First, there was concern that residents would not get the experience with acute cases and resuscitations that they needed if those were distributed across the pods, so the management "stacked four residents in a pod at once," and to accommodate this change, made one pod a non-teaching, non-acute

Table 2c. (Continued) Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

	pod where only attendings and PAs worked. This change was driven by the resident education leadership, and was partly due to the social needs of the residents ("Residents being like dogs who like being with other dogs"). Second, the volume in the ED increased significantly after the redesign, so there were occasions when more than two resuscitations needed to happen at a time. The redesign had only planned for on resuscitation room (in the blue pod) which was able to be used for two patients at once—though not ideally. Ultimately, they kept a resuscitation room open in the Green Pod, even though it was not part of the planned redesign. They began to alternate resuscitations between Blue Pod and Green Pod. Even with the new pods, the management team decided to keep a fast-track area open by the triage area. The fast-track area was adjacent to the Blue Pod. The fast-track area was supposed to be staffed by a PA and a nurse, but the concept was that the residents could come over and see patients if they were not seeing anyone in the Blue pod, although there was a question of whether that was happening in actuality. The fast track beds were expandable, and fast-track stayed open all night. They saw mostly asthmatics and minor orthopedic injuries. This area was implicitly under the supervision of the blue pod attending.

Table 2c. (Continued) Urban Hospital: Background, Description of How the New Work System was Designed, Description of the Redesign, and Description of the Change Process

Change Process	The redesign was an expansion of the existing space, and the planning and change process took place over two years. The planning process involved many staff meetings, with the nurse manager and leadership team trying to get staff input and engagement. Many of the design principles came from the staff themselves, especially around the location of equipment and supplies. The staff also voted to pick the colors of the pods. The actual implementation of the plan was carried out incrementally. Each pod was opened one at a time while the existing ED continued to operate around the construction. The first area that opened was the green pod. The leadership transitioned all providers and patients into that small pod while building different areas. A few months later, they opened half of the orange pod. Finally, blue pod was opened. The full construction process took about six months. There were not significant process changes that accompanied the structural changes, beyond the way that each pod was staffed.

Quantitative Data

Quantitative data were collected from the EMRs of each EDs. De-identified summary records of every patient seen in the ED during the study periods were merged with records of the providers affiliated with each patient case during the patient's time in the ED. At each ED, the record of the patient case included information about the patient's age, race, gender, diagnoses, acuity, mode of arrival and disposition (e.g. admitted to the hospital, deceased, etc.). The record also included timestamps for relevant clinical actions including time at triage and time that the patient was either admitted to the hospital or released from the ED. The providers affiliated with each case were listed using a de-identified staff number and by provider type. The relevant study periods, number of patient cases, and number of providers active during the study period are detailed in Table 3 (page 58).

Qualitative Data

City Hospital

My first visit to the City Hospital ED was two months before the redesign and included a tour and interviews with the ED director and hospital executives. Formal qualitative data collection began six months after the redesign. I spent a week at the ED, observed the pods in action, held informal conversations with ED leadership and staff during meals and between meetings, and conducted formal interviews with the ED leadership team (medical director, nursing director, assistant nursing director, operations specialist, redesign manager) and four frontline providers (two physicians and two nurses). Following an iterative process of reviewing relevant literature and analyzing the formal interviews and archival materials collected during the first visit, I conducted a second site visit one year after the redesign. I again spent a week at the ED, observing the pods, and spending time in informal conversations and meetings with the ED leadership and staff. I also formally interviewed six attendings, six residents, and eight nurses. I judged that I had reached theoretical saturation because the answers to my interview questions were largely consistent across interviewees, and I was not gaining additional insight from additional interviews, even as the specific details, examples, and personalities varied (Strauss & Corbin, 1990, pg. 136). I recruited and found interviewees who had both generally positive and negative views of the new pod system, yet the features that were viewed positively and negatively and the descriptions of how work unfolded in each work design were substantively similar between interviewees. The ED represents a particularly institutionalized setting characterized by rigid work routines and strongly socialized professional role identities and responsibilities (Bartunek, 2011; Pratt, Rockmann, & Kaufmann, 2006; Reutter, Field, Campbell, & Day, 1997). These characteristics are intended to reduce variability, so that any physician or nurse can step into any situation in the ED and carry out their role responsibilities. Eliciting similar substantive descriptions of coordination and social experience within such a regimented system was therefore not surprising. People also described their experience working in the pods similarly at the six month interview and at the twelve month interviews, which suggests the system and related behaviors persisted and were not simply a short-term change.

Metro Hospital

My first contact with Metro Hospital ED was one month before the beginning phase of their redesign and involved phone interviews with the medical director and one attending physician. One month after the redesign, I toured the ED and conducted exploratory interviews with the medical director and nursing director. I and a research assistant conducted three or four hour-long observation sessions at the ED beginning five months after the redesign, with observation happening every three weeks at staggered times (e.g., mornings, evenings, weekdays, weekends) to get a full sense of the varying work flow of the ED. Beginning 10 months after the redesign, I began intensive interviews and observation sessions which took place weekly over the course of about four months. In total, I or a research assistant conducted ten observation sessions, and I conducted forty-eight interviews with the ED staff providers at Metro Hospital (5 members of the ED leadership team, 13 nurses, 10 residents, 14 attendings, six physicians assistants). Similar to the process at City Hospital, I judged that I had reached theoretical when I was not gaining additional insight from additional interviews (Strauss & Corbin, 1990, pg. 136). At Metro Hospital there was more variation in answers *between* role groups, but remarkable consistency *within* role groups, which again can be attributed to strong role identities among physicians and nurses (Pratt et al., 2006; Reutter et al., 1997). The most variation in substantive responses was seen between nurses and other role groups (residents and physicians, and especially management), which is an important finding from this hospital and is discussed in the findings section.

Urban Hospital

My qualitative data collection at Urban Hospital took place 18-months after their redesign. Their new work structure was relatively stable at this point, as compared to City and Metro Hospital, which I observed when their redesign was relatively new (six months and five months, respectively). I spent a week at Urban Hospital, again conducting observation on the ED floor and also conducting interviews with the frontline ED staff. In total, I or a research assistant conducted seven days of observation and 56 interviews. The interviews were with five members of the leadership team, 10 attendings, 19 residents, 11 nurses, seven physicians assistants, and four "techs." There was more evidence of variation between interviewees during the interviews – variation that I would attribute to personality, so it took longer to reach theoretical saturation. Unlike at City Hospital, where responses were largely similar across role groups and at Metro Hospital, where responses were largely similar within nurses and then within other role groups, individual personalities tended to seem stronger than role identity. Could be that the redesign was not as new so the role groups had not coalesced in favor or opposition to the changes. Conducted more inteviews to get a full sense of what was individual variation and what reflected the social or collective experience in the pods at Urban Hospital.

The background material, quantiative data, and qualitative interview and observation data are listed in Table 3.

Table 3. Summary of Quantitative and Qualitative Data

Study Phase	Data and Source	Use in Analysis and Theory Development
Site Selection and Research Design Phase		
	2 books on ED operations and 1 physician memoir of work in the ED read as background material (materials unrelated to selected site)	Develop understanding of the ED context, the nature of the work in the ED, and the traditional ED work design
	11 exploratory interviews with managers and clinical leaders at 4 different urban hospitals; site visits and tours at 2 of these EDs; analysis of written materials on work design and flow from 2 of these EDs	Site selection, support single-site case study design for current analysis
Pre-Post Analysis of City Hospital		
	Semi-structured interviews with 30 key informants, interviews took place 6 months and 12 months after the intervention	Analyze the social experience before and after the redesign, identify mechanisms linking structure and behaviors (Chapter 3)
	Observation on floor of ED • 3 days of observation 6 months after the intervention • 2 days of observation 12 months after the intervention	Triangulate descriptions of coordination behaviors provided during interviews; not explicitly used to develop theory in the coding analysis

Table 3. (Continued) Summary of Quantitative and Qualitative Data

Study Phase	Data and Source	Use in Analysis and Theory Development
	Archival data collected from the electronic medical record. • 6 months of data (~60,000 patient cases) from before the intervention, • 12 months of data (~120,000 patient cases) from after the intervention	Quantify and compare objective coordination behaviors and performance outcomes from before and after the redesign, test mediators (Chapter 3) Quantify and compare performance outcomes of different pod structures (Chapter 5)
Cross-Case Comparison based on Metro Hospital		
	Semi-structured interviews with 48 key informants, interviews took place before and immediately after the redesign, with the majority of interview happening over four months, starting at ten months after the redesign	Conceptualize variation in the pod design, analyze the social experience of working in this design (Chapter 4)
	Observation on floor of ED 10 days of observation over 4 months beginning 10 months after the intervention	Triangulate descriptions of coordination behaviors provided during interviews; not explicitly used to develop theory in the

Table 3. (Continued) Summary of Quantitative and Qualitative Data

Study Phase	Data and Source	Use in Analysis and Theory Development
		coding analysis
	Archival data collected from the electronic medical record. • 29 months of data (~141,000 patient cases) from before the intervention, • 7 months of data (~36,000 patient cases) from after the intervention	Quantify and compare performance outcomes of different pod structures (Chapter 5)
Cross-Case Comparison based on Urban Hospital		
	Semi-structured interviews with 54 key informants, interviews took place 18 months after the redesign	Conceptualize variation in the pod design, analyze the social experience of working in this design (Chapter 4)
	Observation on floor of ED 7 days of observation over a week beginning 18 months after the intervention	Triangulate descriptions of coordination behaviors provided during interviews; not explicitly used to develop theory in the coding analysis
	Archival data collected from the electronic medical record. • 23 months of data (~130,000	Quantify and compare performance outcomes of different pod structures (Chapter 5)

Table 3. (Continued) Summary of Quantitative and Qualitative Data

Study Phase	Data and Source	Use in Analysis and Theory Development
	patient cases) from before the intervention, • 28 months of data (~185,000 patient cases) from after the intervention	

Quantitative Analyses

In-depth case study of City Hospital (Chapter 3)

The quantitative analysis conducted as part of the in-depth case study of City Hospital focused on whether there were significant performance differences between the new (team scaffolds) and old (unbounded role-based coordination) work designs and whether this difference was partially due to the challenge of coordinating with a larger versus smaller number of interdependent role occupants, which involved testing group size as a mediator. I used operational data from the ED's electronic medical records (EMR). De-identified summary records of every patient seen in the ED during the 18-month study period (6-months before the redesign and 12-months after the redesign) were merged with de-identified records of the providers affiliated with each patient case. Testing performance differences using operational data was relatively straightforward. Testing for differences in group size, and determining whether these differences mediated the relationship between team scaffold implementation and performance required careful consideration of how to structure the data to assess these variables and relationships. The first consideration was how to define group size. Although change in group size could be understood as a change from an entire department caring for all patients to smaller subdivided groups caring for smaller sets of patients, this does not adequately describe people's actual experience working in unbounded role-based coordination compared with working in team scaffolds. To capture the change in coordination experience, I thus adapted a network measure (ego network size) to measure how many partners each focal individual actually coordinated with in providing care to patients.

The second consideration was how to define the networks within which each focal provider's ego network size (based on number of partners) could be determined. One logical way to slice time into discrete periods in a setting organized around shiftwork is to calculate number of partners within a single shift, because all of the people who could work together would be contained in that time slice. However, shifts in the ED are staggered, such that a single clean shift break, as occurs in many production settings, never occurs here. I therefore created 24-hour time slices within which to measure number of partners and performance. Using the list of possible shifts provided by the ED leadership, I determined that creating 24-hour slices of time starting at 7am would break up the fewest number of shifts between two slices. I created the 24-hour slices by including any patient case and affiliated providers with a triage timestamp after 7:00:00am on a given day and before 7:00:00am the next day. This resulted in collapsing the unit of analysis from the patient case (N≈160,000) to 24-hour periods lasting from 7am to 7am (N=545). To determine the number of partners with whom a focal provider coordinated patient care, I constructed a two-mode network linking physicians and nurses through each of their shared patient cases and then constructed an affiliation matrix (Borgatti & Everett, 1997; Wasserman & Faust, 1994).

Two representative 24-hour periods, one from before and one from after the redesign, matched on number of patients and number of staff, are illustrated in Fig. 2 (page 80) (Borgatti, Everett, & Freeman, 2002).

Quantitative Measures

Performance A critical measure of ED performance is efficient throughput of patients. Performance was thus calculated as the average throughput time (i.e. the total time a patient is in the ED, from triage to disposition) for a 24-hour period, based on the timestamps contained in the EMR.

Pod implementation The implementation was designated by a dichotomous variable indicating time before or after the redesign.

Total Staff I calculated the total number of providers who worked during each 24-hour period by summing unique provider IDs within each 24-hour period.

Partners I calculated the number of partners with whom a focal provider worked during her or his shift, averaged across providers over a 24-hour period. This was the count of the number of non-zero entries in the projected affiliation matrix divided by the number of rows (i.e., average ego network size).

Control Variables I included several operational and temporal control variables, detailed in Table 4.

Table 4. Control variables used in analysis of pod impact on throughput

Operational Control Variables	
Volume of patients by Emergency Severity Index level	A significant factor in operational throughput time was how complicated each patient case is. This was difficult to control for at the 24-hour level. I broke out patient volume for each 24-hour period by Emergency Severity Index level (1-most acute, 5-least acute).
Day of week	Like many EDs, City Hospital experienced substantial fluctuation of volume across different days of the week (e.g. Mondays were reported to be the busiest days). Different days were likely to be associated with different types of patients (e.g. more trauma cases on weekends).
Temporal Control Variables	
Dummy and trend variables were created for phase 1 (study begins), phase 2 (upstaffing begins), phase 3 (training begins, and phase 4 (pods go live)	

Using number of partners and control variables calculated for each 24-hour period, together with the throughput time for the matching 24-hour period as the outcome variable, I conducted a segmented regression analysis. Segmented regression analysis of time-series data estimates how much an intervention changed an outcome of interest by controlling for baseline, transition, and post-intervention level changes and trends (Smith et al., 2006; Wagner, Soumerai, Zhang, & Ross-Degnan, 2002). It is a form of interrupted time series analysis, which is the strongest experimental design to evaluate longitudinal effects of time-delimited intervention (Cook & Campbell, 1979). Auto-correlation, which violates the assumption of independent observations, is likely in consecutive time periods in an ED; the Durbin-Watson measure (0.93) indicated auto-correlation in our data, so I used Newey-West regression models to adjust standard errors.

I next analyzed whether number of partners mediated the relationship between pod implementation and throughput. I tested two variables that were likely to have been affected by the implementation – total staff and number of partners. Total staff increased because the pods necessitated more people working in the ED at any time, which may have improved throughput time. Number of partners was likely constrained by the pods, which may also have improved throughput time by reducing coordination costs. I performed a mediation analysis for total staff and number of partners using a Sobel test (Baron & Kenny, 1986; Sobel, 1982) and a boot-strapping test (Edwards & Lambert, 2007; Shrout & Bolger, 2002) (stata commands: *sgmediation* and *bootstrap sgmediation*).

Cross-site analysis of pod performance (Chapter 5)

My second quantitative analysis was intended to be an analysis of the performance of team scaffolds. My research setting did not support this analysis because team scaffolds were not successfully enacted in every ED. In response to this empirical reality, I instead focused this analysis on analyzing pod performace, independent of whether the pods would qualitatively qualify as team scaffolds. The pods represent self-contained sociotechnical systems with dedicated physical resources and relatively stable levels of human resources (Emery & Trist, 1969). Within the pod work systems, patterns of coordination are enacted by the fluid groups that populate them (Barley & Kunda, 2001; Emery & Trist, 1969). An analysis of pod performance should therefore consider the time-invariant characteristics that might influence performance, the levels of staffing deployed within each pod, and also the properties of the coordination patterns enacted within each pod.

I employed the archival operational EMR data provided by each hospital to construct a coordination pattern for each pod for each day. I used each patient case seen in each pod to construct a two-mode network and then an affiliation network which represented the coordination pattern in each pod for a 24-hour period (again bounded by a 7:00:00am cut-off to define the period). The unit of analysis was therefore the coordination pattern in a given pod for a given 24-hour period, matched with the outcome variables for the corresponding 24-hour period. This allowed me to test the time-invariant characteristics of the pods (using fixed effects analyses), and to quantify the properties of the groups that were populating the pods for a day – properties like group size, coordination patterns, and familiarity – and assess whether those properties mattered for pod performance.

Quantitative Measures

Operational Performance Operational performance was again calculated as the average throughput time (i.e. the total time a patient is in the ED, from triage to disposition) for a 24-hour period. For this analysis, throughput time was calculated for each separate pod.

Quality Performance Quality performance was measured as 72-hour bounceback, or the number of patients seen in each pod who returned to the ED for medical care within 72-hours after being discharged, divided by the total number of patients seen in the pod during that day. 72-hour bounceback is a commonly used measure of ED quality, but is not generally regarded as a strong quality indicator because it tends to reflect first visits associated with alcohol or mental illness (Newton et al., 2010; Pham, Kirsch, Hill, DeRuggerio, & Hoffmann, 2011). I include it in the descriptive statistics because it is one of the only quality metrics for ED care, but I do not include it in the formal hypothesis test.

Attending, Nurse, Resident and Staff Ratio I calculated the number of attendings, nurses, and residents (or physicians assistants) who worked in each pod during each 24-hour period by counting the number of unique provider IDs for each provider type. I also calculated the number of patients who were seen in each pod for the same period. I calculated the number of attendings per patient, number of nurses per patient, and number of residents per patient. These ratios were highly correlated, so for the regression analyses I aggregated the number of staff and instead included the number of staff per patient in each pod.

Group Familiarity I created an affiliation matrix for each 24-hour period based on how many times each dyad had worked together in a pod in the past 90-days. I then calculated the familiarity of the entire group populating a pod during a 24-hour period by summing each cell in the matrix and dividing by the total number of cells in the matrix. Note that this measure gives providers "credit" for having worked together in a pod in the past, even if they did not directly coordinate on patient care. Nurses would often help each other while working together in a pod, but rarely worked together directly on the same patient (i.e., only one of them would enter in their provider ID number into the EMR as the nurse responsible for the patient).

Shared Patients I calculated the average number of times each focal provider worked with his or her partners. This was the sum of the row-averages (of non-zero entries) within the projected affiliation matrix for the 24-hour period for each pod, divided by the number of rows.

Attending, Nurse, Resident Partners I calculated the number of partners with whom each type of provider worked during her or his shift, averaged across providers over a 24-hour period. This was the count of the number of non-zero entries in the projected affiliation matrix divided by the number of rows (i.e., average ego network size) for the pod.

I first calculated descriptive statistics for all ten pods (four in City Hospital, three in Metro and Urban Hospitals), including a description of pod layout and a visualization of a randomly selected 24-hour coordination pattern in the pod (Borgatti et al., 2002). The descriptive statistics were used to assess the amount of variation among pods at each site on independent and dependent variables. I then analyzed pod performance at three different levels: within-pod, within-hospital, and across hospital. A within-pod analysis compares the coordination pattern enacted by each fluid group that populated each pod and how they performed compared to the other fluid groups in that same pod. This analysis allowed me to look at what properties of the coordination pattern influenced performance within each pod, and also to look for patterns of results from this analysis. This was a simple regression of study variables onto throughput time for each pod (stata command: *reg*). A within-hospital analysis allows me to quantify how much variation in pod performance is between pod and how much is within pod, and to examine how the study variables relate to performance within each hosptial. This is a fixed effects regression of all the fluid groups in all pods in each hospital (stata command: *xtreg, fe*).

Finally, an across hospital analysis of pod performance examines which properties of the coordination patterns are associated with pod performance, even controlling for the time-invariant properties of the pods and the different hospital sites (stata command: *xtmixed*). All variables were standardized for this analysis.

Qualitative Analyses

In-depth case study of City Hospital (Chapter 3)

My qualitative data analysis for the study of City Hospital was informed by the background material, site visits, and observation described in Table X, but my formal qualitative analysis was focused on coding the formal recorded and transcribed interviews. I first wrote a vignette describing the history of the ED, the impetus for and process of changing the work design, and the general nature of the change that had occurred. From this descriptive case study, I learned that the change had been structural (as opposed to a behavioral intervention such as teamwork training e.g., Haller et al., 2008). I therefore adopted a high-level theoretical framework consistent with literature that suggests that organizational structures influence work behavior (Barley & Kunda, 2001; Hackman, 2002; Hackman & Oldham, 1980). I coded every interview sentence into one or more of three overarching themes consistent with this framework. These themes included structure, behaviors, and mechanisms. Once I had grouped quotes into these broad themes, I conducted line-by-line analysis of every quote within each theme to identify common ideas (Miles & Huberman, 1994; Strauss & Corbin, 1990).

I did not know the exact nature of the structures that had been implemented when I began the project. Data relating to the new structures contained descriptions of the layout, staffing, and work flow of the pods. I focused on understanding how the descriptions specific to this work context related to existing literature. Through this iterative process I realized that the new structures embodied the logic of role-based coordination and team effectiveness, so chose labels that reflected these literatures. For example, interviewees did not describe the pods as being comprised of bounded role sets, but rather described the pods as having an explicitly designated group (which relates to the definition of a team boundary (e.g., Hackman, 2002)) and having “plug and play” roles within the pod (which typifies the research on role-based coordination (e.g., Klein et al., 2006). I then adopted a conceptual label that related our data on the new structures to the existing literature.

I also analyzed the many descriptions of coordination behaviors in the pods. I focused on providing rich description of the behaviors and identifying higher order categories that encompassed key behaviors. Interviewees gave vivid descriptions of coordination in the pods. My initial coding resulted in seven categories of behaviors, which I collapsed into three higher-order categories. For example, many quotes described communicating in informal feedback loops, which I first coded as “opening and closing feedback loops” and many related quotes described monitoring each other’s progress on tasks that were the focus of the feedback loops. I ultimately coded those quotes as “opening, monitoring, and closing feedback loops,” which is one of my higher order categories and represents ideas expressed by almost every interviewee. My purpose was not to provide an exhaustive taxonomy of coordination behaviors or introduce a new construct, but to describe richly a dramatically new coordination in this context. My label for the new behaviors (fast-paced teaming) relates to previous constructs such as mutual adjustment (Thompson, 1967), team work flow (Van De Ven et al., 1976), and dialogic coordination (Faraj & Xiao, 2006), but we chose this specific label to capture the idea that people can engage in effective teamwork even in the absence of stable teams (Edmondson, 2012), and to illustrate the kinds of behaviors that might be involved.

I also conducted line-by-line coding of every interview quote related to mechanisms – the "theoretical cogs and wheels that explain how and why one thing leads to another" (Anderson et al., 2006, pg. 102). These were quotes where people explained the conditions the pods created and how those conditions supported the new coordination behavior. I analyzed each quote, developed codes, tested the codes against additional quotes, revised the original codes, and continued to test and refine. Some of my early codes were retained through that entire process. For example, the codes for quotes describing how the pods created "proximity" captured ideas expressed by the majority of the interviewees using relatively similar language. Additional quotes provided insight into how that mechanism worked (e.g., reducing social barriers), but did not require material revision of the category. Other quotes captured more nuanced experiences that were described with varying language, but that I ultimately understood to be referring to the same higher-level category. As an example, codes that ultimately comprised the higher order category of "visibility" included being overwhelmed by too much to attend to, and of being unable to monitor the progress of individual patients because of having many coordinating partners. With analysis of many interviews, I began to understand that each of these descriptions were about being unable to see work progressing because there was too much to attend to previously (including space, patients, and partners). Related quotes reflected an improved visibility of work progress after the pods framed a work domain and partners for each provider. I followed this same process of iteration until I arrived at categories that best fit my data. I used a research assistant to code a random selection of interviews as a check on my coding structure (Yin, 2003).

Cross-case Comparison (Chapter 4)

Consistent with best practices for developing theory using case studies (Eisenhardt, 1989; Eisenhardt & Graebner, 2007), I began the cross-case comparison by developing a within-case analysis for each field site. These within-case analyses were purely descriptive, but were "central to the generation of insight" (Eisenhardt, 1989; Gersick, 1988). Part of these descriptive case studies are reported above in the descriptions of each field site and their change process.

I next compared each site to the other sites (i.e., City to Metro, Metro to Urban, City to Urban) to develop understanding of the similiarities and differences between each pair. The result of forced comparisons can be "new categories and concepts which the investigators did not anticipate" (Eisenhardt, 1989). This was indeed the case – during the process of the forced comparisons I began to see differences and similarities in how patients were allocated to the pods at the different sites. Although this process was a common topic in the interivews in my first field study, it did not emerge as an important theme in my findings because it was not conceptually relevant in a comparison of role-based coordination and team scaffolds. In a comparison of team scaffold design, it emerged as a key difference in how people understood and enacted their shared work in the pods. I also grouped all of the field sites together and compared them on the team scaffold dimensions identified by the intial case analysis. This forced me to "go beyond my intial impressions through the structure lens provided by the data" (Eisenhardt, 1989, pg. 542), and also allowed me to realize the novel findings that exist in my data.

I implemented each of these initial strategies to help me make sense of the large quantities of interivew and observation data I had gathered. They helped me identify overarching themes, like boundedness, ownership, work allocation, and teamness, that came up in interviews and differed across sites. Using these overaching themes as an initial broad framework, I conducted line-by-line analysis of every interview to understand how these themes were described, and especially the relationships between them (Miles & Huberman, 1994; Strauss & Corbin, 1990). This was an iterative process, as I developed ideas and discarded or revised them as I tested them against additional interview data. I also iterated my ideas with existing literature. As an example, an early code that seemed important was the idea of alignment between the interests and efforts of physicians and nurses. As I tested this idea with more interviews and a literature search, I found that it was more consistent with my data and more relevant to the literature to conceptualize the idea in terms of a mismatch or mixed signals between individual and group ownership, similar to Wageman (1995) and Hackman (2002) and Alderfer (1976). I followed this same process of iteration until I arrived at categories that best fit my data.

CHAPTER 3. FINDINGS: TEAM SCAFFOLDS

Chapter 3 reports results and findings from an in-depth case study of the team scaffold implementation at City Hospital. Quantitative analyses use data from the EMR, aggregated into 24-hour time slices that capture daily coordination patterns and performance. The analyses test performance differences between unbounded role-based coordination and coordination in team scaffolds, and whether group size – defined as the average number of partners a focal provider worked with during a 24-hour period (ego network size) – mediates this relationship. Qualitative analyses use interview data collected from physicians and nurses at City Hospital and support conceptualization of the pod structures as team scaffolds, and reveal new coordination behaviors and the mechanisms that link the structures with the new behaviors.

Results

Table 5 reports correlation between study variables. Figure 1 displays throughput time over the entire study period. Total staff in the department increased from 75 to 80 for an average 24-hour period after the redesign (Table 6). Functional group size – i.e., the formal group responsible for a set of tasks –is best understood as the difference between 75 people caring for all the patients in the ED during a 24-hour period, compared with 29 people (the average number of people that flowed through a pod during a day) caring for a subset of the patients in the ED. Group size, defined as the average number of partners each focal provider coordinated patient care with, was significantly reduced by the pod implementation: providers coordinated with four fewer partners on average. This effect was more pronounced for nurses, who coordinated with seven fewer physicians, than for attendings and residents, who coordinated with five and three fewer nurses during a 24-hour period, respectively.

Table 5. Correlations between Study Variables

	Variable	1	2	3	4	5	6	7	8	9
1.	Pod Implementation									
2.	Average Throughput Time	**-0.77**								
3.	Partners	**-0.69**	**0.75**							
4.	Total Staff	**0.26**	0.03	**0.13**						
5.	Volume of ESI 1 patients	**0.09**	**-0.09**	**-0.19**	-0.06					
6.	Volume of ESI 2 patients	**0.24**	**-0.24**	**-0.18**	0.08	0.07				
7.	Volume of ESI 3 patients	**0.43**	**-0.14**	-0.02	**0.56**	-0.03	**0.09**			
8.	Volume of ESI 4 patients	**0.53**	**-0.36**	**-0.23**	**0.39**	0.03	**0.21**	**0.49**		
9.	Volume of ESI 5 patients	**0.42**	**-0.33**	**-0.23**	**0.21**	0.08	**0.23**	**0.38**	0.45	

Note. Bold denotes significance of less than 5%. ESI stands for Emergency Severity Index, 1 is most urgent 5

Figure 1. Throughput time (hours) over Study Period

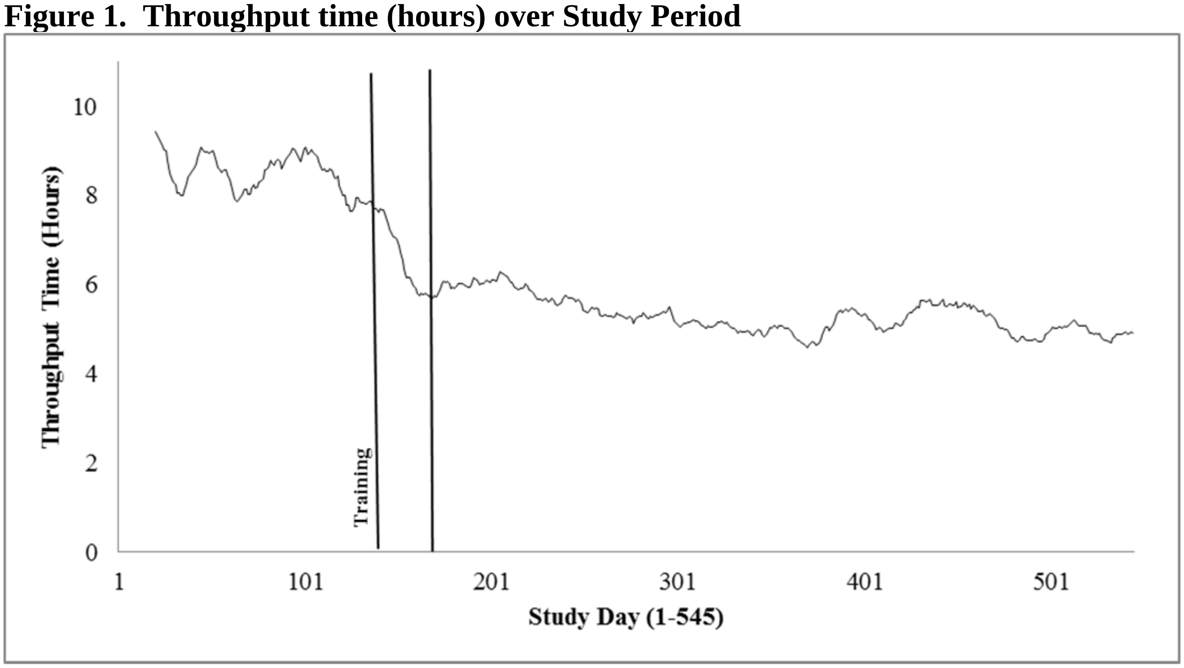


Table 6. Group Size (Functional and Number of Partners) Before and After the Pod Implementation

	Within 24-hour period		At any time (on average)	
Functional Group Size	Before	After	Before	After
Department	75	80	53	53
Pod	-	29	-	16
Number of Partners	17	13	11	8
Stratified by Provider Group				
Nurses	19	12	14	9
Attending Physicians	17	12	10	8
Resident Physicians	17	14	11	9

The pod redesign was significantly associated with improved operational efficiency in the ED (Table 7, Model 1). Even after controlling for various intervention phases, baseline trends, and other operational characteristics, patients' average time in the ED (throughput time) after pod implementation was three hours shorter than before - a nearly 40 percent reduction in time from the previous average throughput time of eight hours. Variables reporting total staff and number of partners were entered in Model 2. All coefficients are significant in the expected direction (i.e., more staff is associated with reduced throughput and having more partners is associated with longer average throughput). When both the indicator for the pod intervention and total staff and partners were entered into Model 3, the coefficients on pods and partners were significant but attenuated. This result shows that having fewer partners partially mediated the relationship between pod implementation and throughput time: 38% of the impact of the pods on throughput time could be accounted for by the reduction in partners. Total staff did not mediate the relationship between pod implementation and throughput: simply hiring more people would not have improved performance – instead, the way that they were organized made the difference.

Additional analyses conducted to address the question of whether the effect was due to the addition of extra staff were suggestive that the pods had an independent and significant effect. First, in the segmented regression analysis, the three-week period of upstaffing was associated with a one-hour improvement in operational efficiency compared with the pre-pod period, and the pod implementation was associated with a three hour improvement, meaning the pods had a two hour marginal effect on the efficiency of the department. Second, the results of the analysis comparing the 24-hour periods matched using propensity score matching (based on the number of staff and the number of patients treated in a 24-hour period) were similar; there was over a three hour difference between the pre and post periods.

Other sensitivity analyses also revealed similar patterns of results. An analysis using the patient case as the unit of analysis (instead of a 24-hour period of time) revealed a three hour improvement in throughput following the pod implementation. Also, an analysis using 8-hour time slices rather than 24-hour time slices (chosen to reflect changes in attendings' shifts: 7:00am, 3:00pm, 11:00pm) revealed the same pattern of results.

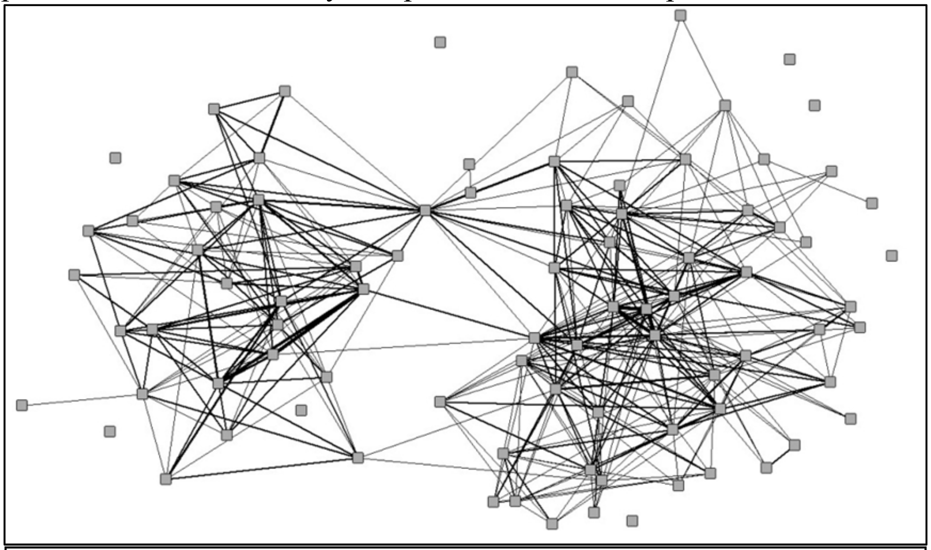
Two randomly selected 24-hour periods, one from before the redesign and one from after the redesign are shown in Figure 1 (page 80). The coordination network patterns were illustrated using UCINet software (Borgatti et al., 2002).

Table 7. Segmented Regression Analysis of Pod Implementation and Coordination Patterns on Throughput Time (hours)

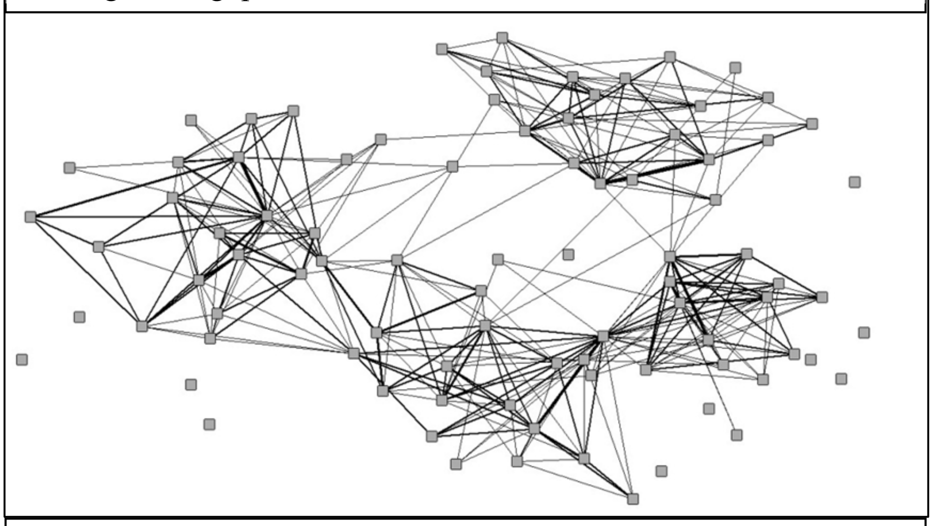
	Dependent Variable: Throughput Time		
	(1)	(2)	(3)
Pod Implementation	3.1144***		1.5491***
	(0.1702)		(0.1981)
Partners		0.3359***	0.2395***
		(0.0184)	(0.0213)
Repeat Collaborations		-0.5010**	-0.3109*
		(0.1586)	(0.1521)
Number of Attendings	0.0058	-0.0822**	-0.0163
	(0.0281)	(0.0249)	(0.0250)
Number of Residents	0.0413**	0.0088	0.0230+
	(0.0143)	(0.0142)	(0.0136)
Number of Nurses	0.0020	0.0510***	0.0350***
	(0.0087)	(0.0089)	(0.0086)
Volume in ESI 1 patients	0.0141	0.0010	0.0110
	(0.0185)	(0.0173)	(0.0164)
Volume in ESI 2 patients	0.0110**	0.0152***	0.0121***
	(0.0038)	(0.0036)	(0.0034)
Volume in ESI 3 patients	0.0105***	0.0076***	0.0094***
	(0.0021)	(0.0020)	(0.0019)
Volume in ESI 4 patients	-0.0051+	0.0100***	-0.0049*
	(0.0028)	(0.0025)	(0.0025)
Volume in ESI 5 patients	-0.0120*	-0.0116*	-0.0084+
	(0.0054)	(0.0050)	(0.0048)
Average diagnoses/case	0.4670	-0.6259+	0.0362
	(0.3523)	(0.3188)	(0.3136)
Constant	4.9975***	6.4444***	4.6140***
	(0.6910)	(0.8977)	(0.8817)

Notes. +,*, ** and *** denote significance at the 10%, 5%, 1% and 0.1% levels, respectively. All models include, but results are not shown for the following variables: day of week, time before pods were implemented (trend), upstaffing period (level and trend), training period (level and trend), and time after the pods were implemented (trend)

Figure 2. Examples of coordination patterns before and after the redesign
Coordination patterns based on 24-hour periods of time. Before and after were matched by number of patients, and number of attendings, residents, and nurses. Gray squares represent providers. Lines represent more than one shared patient case; weight of the line (four possible weights) indicates number of shared patients. Some squares are not connected: those represent providers who shared only one patient with various partners.



One 24-hour period before the redesign.
291 patients, 81 staff (43 nurses, 12 attendings, 26 residents)
Average ego size: 16.7
Average throughput time: 7.9 hours



One 24-hour period after the redesign.
294 patients, 76 staff (38 nurses, 15 attendings, 23 residents)
Average ego size: 13.1
Average throughput time: 4.2 hours

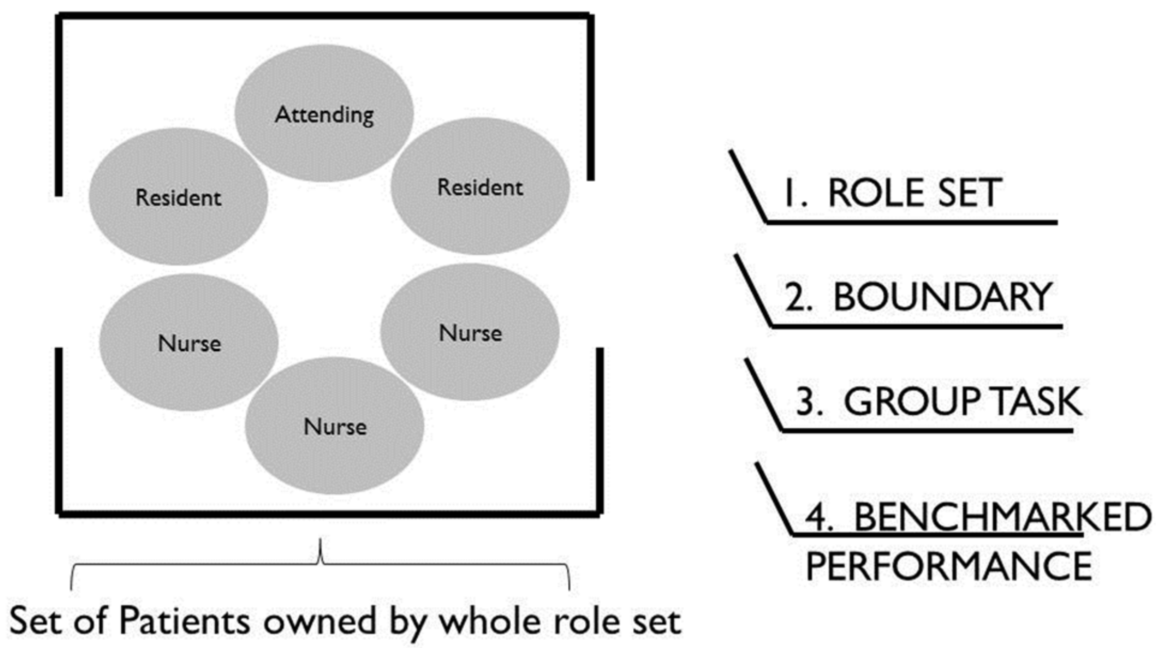
Findings

Qualitative data analyses reveal that team scaffolds incorporate the logic of role-based coordination and the logic of team effectiveness theory; they structured work around de-individualized roles rather than specific individuals and bounded a small set of roles with group-level ownership over shared work. In this section, I conceptualize the team scaffolds, dimensionalize the group-level coordination processes enabled by the team scaffolds, and identify the mechanisms that link these structures with these processes (behaviors).

Dimensions of Team Scaffolds

The team scaffolds consisted of a boundary, a role set, and group-level ownership of shared work (see Figure 3). The boundary included an actual physical barrier: a counter circumscribed the space within which nurses and doctors worked together. In contrast to the boundaries in stable teams (Hackman, 2002), it was a de-individualized boundary defined by space and a set of roles not by people; it did not help people know each other's names or identities (I sometimes saw people introduce themselves after working in a pod together for an hour). But the boundary made it possible to quickly identify interdependent partners, even without knowing each other. One attending described how fluid the groups populating in the pods were, saying, "It is a totally different team most of the time," and a nurse explained how the boundary enabled people on these extremely fluid teams to identify each other: "It is not hard to keep track of who you are working with anymore – you just look over and see who is in the pod with you." The interviews revealed that people did not "look over" and necessarily recognize the individuals with whom they were working – rather they looked over and accepted that the co-located

Figure 3. Team Scaffolds at City Hospital



person was on their team. Boundaries are often associated with enduring identity in communities and groups (Lamont & Molnar, 2002), so the use of a de-individualized boundary – i.e., one that did not delineate specific individuals and therefore could not establish enduring identity – to signal partners among relative strangers is intriguing, particularly because the de-individualized boundaries still ended up establishing a minimal in-group for the providers who were temporarily working together in a given pod. I discuss the in-group dynamic more below.

Enclosed within this explicit boundary was a role set: a small group of roles with the complement of skills needed to accomplish shared work. Role sets functioned similarly to role *structures* described in previous research (e.g., Klein et al., 2006). A resident explained, “If you have clearly defined roles and plug somebody else in who knows what they’re doing, it’s going to continue to function fine.” The difference is that the role *set* was small and bounded, in contrast to the loose and unbounded role structure in place before the intervention, in which any combination of nurse, resident, and attending could work together. People experienced working together in an unbounded role structure and a bounded role set differently. One resident described the difference: “Working with a set group of nurses during your shift means you know whose attention you need to draw to something. You also know people’s names a little better, to be honest, as silly as it sounds… You learn their names, and you’re getting them involved.” This representative quote suggests that role interdependence did not provide enough structure in this situation where people did not work together regularly.

Finally, the team scaffolds included group-level ownership of a set of patients. As patients entered the ED, they joined the queue for a specific pod (rather than for the entire department) such that each pod had ownership over a set of patients. The patient queue for each pod grew or shrunk depending on (among other things) how effectively the people populating the pod at a given time worked together. Hackman’s (2002) team effectiveness theory recognizes interdependence (along with boundedness and stability) as a key and defining design feature of a real team, arguing that a stable bounded group of people lacking interdependent work will not function as a team (Hackman, 2002). Empirical research supports the proposition (Sprigg, Jackson, & Parker, 2000; Wageman, 2005). My findings reveal benefits of interdependence that is designed around a whole task, start to finish, for role occupants (Hackman & Oldham, 1980). The nurses and physicians we studied were always interdependent in providing patient care (their respective skills and effort were combined in treating patients before and after the redesign), but the interdependence was often treated sequentially before the redesign, akin to hand-offs between workers on an assembly line (Thompson, 1967). People experienced individual ownership of their tasks (their segments in the assembly line), rather than feeling shared ownership over the whole task. The team scaffolds' group-level ownership for a set of patients set thus changed how interdependence was experienced and enacted: providers became focused together on "moving patients out" (to discharge or hospital admission), and were interdependent in getting this done, rather than in simply executing separate role-based tasks. Representative data illustrating the team scaffold design are reported in Table 8 and the two different coordination structures are displayed in Figure 4a and Figure 4b.

Table 8. Representative data describing Team Scaffold Dimensions at City Hospital

Role Set	"If you have clearly defined roles and plug somebody else in who know what they're doing, it's going to continue to function fine." (Resident)
Boundary	"[Within a single shift] I have a designated group of nurses [and] a faculty that's assigned to me." (Resident)
Whole Team Task	"Patients are assigned to your pod, and you own them, no ifs ands or buts" (Attending)
Benchmarked Performance	"You can look at the computer and see how many patients are in your [pod's] queue." (Nurse)

Figure 4a. Work flow before the redesign at City Hospital

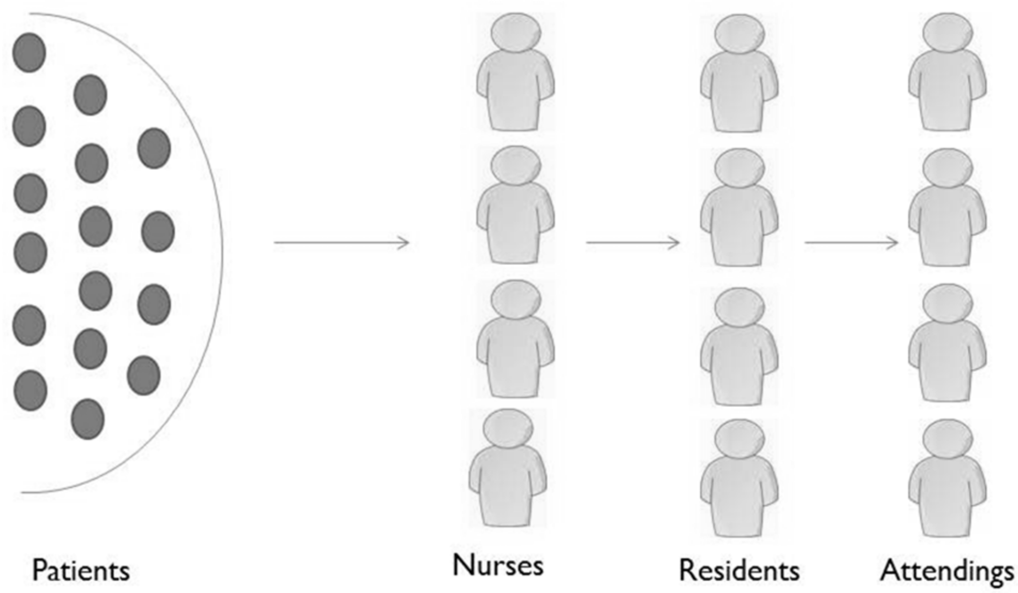
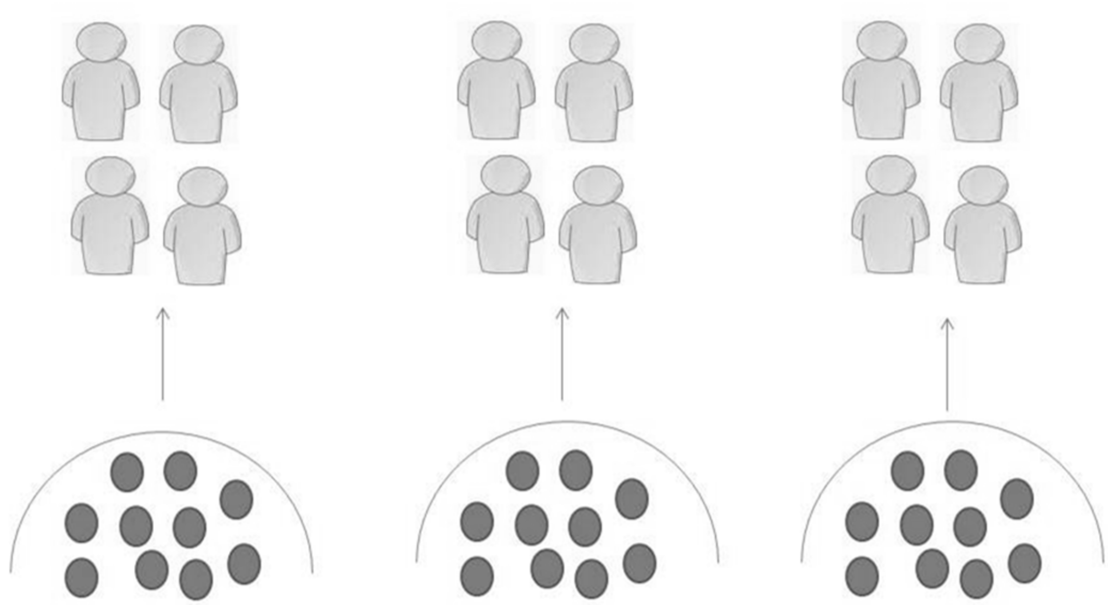


Figure 4b. Work flow after the redesign at City Hospital



Sequential Role-based Coordination versus Fast-Paced Teaming

The team scaffolds changed how interpersonal coordination worked. Coordination began to take the form of fast-paced teaming, with a shared focus on completing a full episode of care, instead of sequential coordination, where individuals focused on completing separate role tasks. Teaming refers to real-time mutual adjustment between interdependent workers (Edmondson, 2012), and is conceptually similar to the active real-time coordination between role occupants identified in previous research (e.g., Faraj & Xiao, 2006; Klein et al., 2006). In contrast to previous research, the descriptions below capture teaming as it unfolds over a shift – not just in single trauma cases – as providers endeavored to balance competing priorities. Role occupants, supported by a team scaffold, were surprisingly able to sustain active *group*-level coordination over time.

Role-based Sequential Coordination Before the redesign, role-based tasks unfolded sequentially. When mutual adjustment of priorities was needed, it tended to occur through face-to-face communication in one-off *ad-hoc* combinations. This system inhibited effective coordination. People were often unsure with whom they were working, or where to find that person when he or she was needed. One resident reported having to ask other residents what the nurse looked like who had just written in the patient chart, so as to follow-up with that nurse. A nurse told of a similar experience: "It was very segregated. You'd have to figure out who the doctor was, go find them—who knew where they were?—and then you had to address them." Many people described approaching someone to discuss a patient and being told, "That's not my patient." Relatedly, physicians coordinated with many nurses. A nurse explained,

> Before [the redesign], the doctors could have multiple nurses reporting to them on different patients, [such that] they didn't even know who the nurse was for each patient most of the time. So your patient would get admitted and you'd have no clue why. It was like being a monkey, kind of just following or giving medications and moving through this line. You had no explanation of the end result for why it was going in that direction.

Another nurse told me that because of this dynamic, people tended to focus on the task at-hand without a sense of the overall wait in the ED and without a clear way to prioritize their own and each other's efforts.

Coordination as Fast-Paced Teaming After the pod redesign, coordination still involved role-based tasks but was more interdependent in completing full episodes of care. A completed episode of care involved stabilizing and diagnosing patients and moving them out of the ED. With everyone engaged in the shared task of moving patients through a care episode, communication became more frequent and focused, decreasing the time delays between each step of the process and thereby reducing the total time taken to provide care to each patient. Furthermore, the process of moving a patient through an episode of care could occur in parallel for multiple patients. The nurses and physicians interacted constantly, improvising to adjust expectations, treatment plans, and overall understandings of the many, often competing, priorities in the pod.

Interviews revealed three important collaborative behaviors: communicating information to determine or adjust priorities, opening and closing feedback loops, and helping each other. Communicating information about priorities allowed small tasks with the potential for significant patient movement to occur before longer tasks that would not affect patients as quickly. One nurse described:

> If the docs need something urgent they'll say, "Hey, this is just the one last thing we need," and then I'm going to try to make that blood pressure happen before I go do something else that's going to take ten or 15 minutes. I know that BP can take two minutes, and then we can get somebody out of there.

Adjusting plans to accommodate each other's priorities was critical to teaming in this setting, and sometimes took extensive discussion to determine whose opinion about the highest priority should be followed. This kind of negotiation of priorities happened rarely before pods were implemented, because there was a lack of visibility of shared and competing priorities and a lack of shared ownership of each patient through a full episode of care.

People working together in a pod were likely to verbally ask for things, check-up on requests, and confirm that something had been done. Some of the physicians referred to this as a feedback loop, which was part of the formal protocol for patients who "coded" (i.e., whose hearts stopped beating). In the pods, the feedback loops were adapted to an informal teaming dynamic as well. One of the residents explained

> So much of what we do changes minute to minute. [The pods] allow us to interface with each other in the whole closed loop communication. That really matters in what we do because priorities change constantly. If you can actually communicate that [priority change] to someone directly as opposed to putting an order in the computer, it makes a huge difference…. You give the order, someone repeats the order, and then you confirm that that's the right order.

Most interviewees described such feedback loops. A nurse said, "I would say [interactions like this are] about 80 to 90 percent of the time for the people I work with. They're like, 'Hey, just to let you know, I've got this done,' and I'm like, 'Thanks.'" An attending offered a similar perspective, "On a good shift, there is a positive feedback loop verbally. There is a lot of verbal communication. People are telling each other what's going on." Frequent communication to open and close feedback loops was reported to be largely absent before pods were implemented.

Another aspect of teaming in the pods was helping each other. Help was given by directly taking on someone else's responsibility, anticipating another clinician's need, or adjusting behavior to accommodate a recognized weakness. Residents described doing some of the nurses' duties if the nurses "were slammed." Another nurse suggested that they traded responsibilities to help each other out:

> I'll be like, "Hey, I'm having a really hard time sticking this lady. Would you go do this one? I'll go start your liter." Kind of just trading responsibility to help one another out. That way, it's not one person getting the brunt of work if someone else is struggling.

Several nurses and physicians also described recognizing a weakness in one of their pod mates, and adjusting to the weakness. For example, one nurse said that she could tell that when working with a certain attending "the pod was going to expand a bit more," so she took on several extra responsibilities to keep the pod moving.

Table 9 reports additional data to illustrate the behaviors that comprised fast-paced teaming in this setting.

Table 9. Teaming

Teaming Behaviors	Data Illustrating Fast-Paced Teaming
Communicating information that helps determine priorities and actions	"If the docs need something urgent they'll say, "Hey, this is just the one last thing we need," and then I'm going to try to make that blood pressure happen before I go do something else that's going to take ten or 15 minutes. I know that BP can take two minutes, and then we can get somebody out of there." (Nurse) "There are all kinds of stuff [communicated in the pods] that weren't communicated before: "Hey, I just added on some lines for the patient in 12 that I forgot to order initially. We need to get vitals on that guy. This new one just came in that I'm a little worried about." We communicate constantly in the pod." (Resident)
Opening, following up on, and closing tasks	"I put in the order, and I wait a little bit and wait a little bit. If I notice that nothing has happened, or the patient hasn't gotten their medication, or the labs aren't showing up as even acknowledged in the computer, I will just go to the Pod Lead or whatever nurse it is and say, 'Hey, do you mind getting that done?' So, it's really just a subtle kind of verbal reminder." (Resident) "You have one particular patient that's been in the waiting room, and it's out of sight, out of mind, but we say, "This patient really needs to be seen. Can you see this patient? Why hasn't this patient been picked up? Why are you skipping over this patient?" It's part of the responsibility of the pod lead to gently remind the physicians." (Nurse) "Sometimes I have to say, after and hour-and-a-half, "Hello?

Table 9. (Continued) Teaming

Teaming Behaviors	Data Illustrating Fast-Paced Teaming
	Have you drawn blood on XYZ patient and, if so, what happened?" And they'll be like, "Oops. She was a hard stick, and I couldn't get a line." Then it's, "Why wasn't I notified?" That's usually not a problem because they'll usually tell me first. I make it a point to say, "Hey, let me know if there are problems, because I like to keep things moving." (Resident)
Helping each other	"Last night the nurse told me "I ordered an x-ray" [on a routine patient]... By the time I finished with my other patient and I went to see her, I could pull up the x-ray. I could see the film and tell that obviously there were no fractures… That helped me expedite the care of her." (Attending)
	"When things are going well, the orders pop up. We say to each other: 'There's three of them. You take that one, I'll take this one, and he's going to take that one.' It isn't a lot of, 'Well, that's not my patient. That's on your bed. You need to take care of that.'" (Nurse)
	"Most of the time when your patients are in a stable state and there's nothing at the moment that you can do for them, you try to find a patient who you can do something for, whether it be give medications or, if they're ready to be discharged, getting their paperwork together and kind of getting them out, because that can help." (Nurse)

Small Group Size

My qualitative data revealed two key factors that explain how team scaffolds improved coordination: small group size and a shared in-group. First, as shown in the quantitative analysis, team scaffolds reduced functional group size, and also each focal provider's number of coordinating partners. People's description of working in the pods reflected this change: they and their temporary team mates felt a new sense of ownership, experienced greater visibility of work, and benefited from proximity to their partners.

Ownership The small group size of the pods created a sense of ownership. In contrast to the prior system in which the entire staff was responsible for the entire department (in which case no one actually felt responsible: residents described taking long lunches because the large department created a sense of "anonymity" and would still "look like crap" no matter what any individual did), a small group took responsibility for a small queue of patients. Interviewees in all three role groups expressed ownership for how the pod performed, and most attributed the same to other role groups as well. A resident reported, "The attendings do feel ownership, and I think the Pod Lead Nurses do. I think everybody feels like, 'It's my pod. I have a sense of ownership with it." Team effectiveness research has shown that large group size in stable teams contributes to social loafing because individual effort cannot be detected (Harkins & Szymanski, 1989; Kidwell & Bennett, 1993) and also inhibits coordination (Alnuaimi, Robert, & Maruping, 2010; Mockus, Fielding, & Herbsleb, 2002) – both of these dynamics were apparent before the pods were implemented. Diffuse ownership – which actually feels like anonymity rather than ownership in a sea of relative strangers – is one reason why roles may not provide enough structure for optimal coordination.

Visibility The small group size also enabled fast-paced teaming by making problems visible and clarifying who was responsible for fixing them. A nurse explained, "With a smaller group being responsible for the whole package, you sort of know what's going wrong that day, and it's not just, "Well, nothing is getting done anywhere," throwing your hands up, and just ignoring it," expressing a common feeling before the pods were implemented. People described feeling overwhelmed before the redesign by the implied responsibility for all patients in the ED, and felt relief at being able to see how work was progressing in a pod. Thus the team scaffolds framed both problem domain and the set of collaborators. This function of a team structure (to explicitly frame the work and the collaborators) has previously been implicit in team effectiveness theory, but our finding illuminates the value provided by a team structure in fluid work settings. A defined problem space and set of collaborators ensures the visibility of work, which our data suggest helps people negotiate priorities, monitor task completion, and solve problems.

Physical Proximity The pod ensured that small interdependent groups were co-located, which allowed people to communicate frequently and spontaneously. Frequent and spontaneous communication as a result of co-location was described by many providers as a significant change. One nurse explained that, before the pods, "You had to walk across the ED and be all timid, 'Uh, excuse me?'" She continued, "Now [the doctors] are in the trenches with us." Co-location has long been recognized to support communication (Kahn & McDonough, 1997; Pinto, Pinto, & Prescott, 1993), indeed closer physical distance increases communication exponentially in some settings (Allen

& Sloan, 1970). This finding supports that research, and emphasizes the importance of co-location for interdependent people who do not work together regularly. Limiting the physical distance helped reduce the social distance between the two role groups. The open communication channel established by small groups in a small space proved powerful for overcoming both social barriers and physical distance. Additional data from each of these themes are reported in Table 10a.

Shared Minimal In-Group

I observed that the team scaffolds set up in the pods established a shared minimal in-group for role occupants. Role groups can function as divisive in-groups because of their strong and enduring professional identities (Bartunek, 2011), and may therefore create considerable social distance between role occupants. At City Hospital, the team scaffolds bounded small groups of roles, and this new boundary functioned to create a minimal in-group for the people temporarily together. The minimal structure that was set up was reminiscent of the minimal in-groups studied by Tajfel (1982). In Tajfel's minimal in-groups, no pre-existing relationship was required for people to prefer members of their temporary and arbitrary groups. In the team scaffolds I studied at City Hospital, no pre-existing relationship was required for people to assume membership in the team or take responsibility for the group's shared work, even though the group membership was extremely temporary and constantly changing. The shared minimal in-group gave people an experience of de-individualized belonging. And like any in-group, the people in the pods began to engage in negative behaviors towards their out-groups: the other pods.

Belonging Interviewees expressed a sense of belonging with others in the pod. This was apparent in phrases like “my doctor” or “my nurses” that were used to describe working in the pod. A resident said, “There’s more a sense of camaraderie, a sense that ‘these are my nurses.’” One nurse explained, “Now there is much more of a sense of ownership of each other. I’ll say, “My pod isn’t running well. Where is my doctor?” And he’ll be accountable to me. And the doctors will say, “Where are my nurses, who do I have today?’” People rarely, if ever, claimed each other in this way before the pods were implemented even if they were working together on many shared cases. A resident would have used more detached language like, “Who is this patient’s nurse?” – ignoring that the nurse had any relationship to *him* – rather than, “Where are my nurses?” The data revealed this to be an affective experience. They viewed other providers as accountable to them because they also belonged to the temporary group, making communication seem less discretionary and one-sided.

Competition Almost every interviewee described a new group-level sense of competition between the pods. This was jokingly referred to among the ED personnel as The Pod Wars. The performance metric used to determine who was winning The Pod Wars at any time was the number of patients in each pod’s queue, visible through the computer system. The round robin triage process contributed to this dynamic; each pod was supposed to be “dealt” the same number of patients, so if Pod 1 still had 25 patients when Pod 4 was down to 9, then it was said that Pod 4 was winning. Several people attributed the performance improvements to the urgency and improved work pace that came from the competitive dynamic between pods. One of the nurses explained the competitive dynamic would play out when someone would say, “Pod 1 is killing us!” and then everyone would increase the pace of communication and coordination.

Many acknowledged another aspect to this competition that they viewed as problematic. The competitive dynamic sometimes prevented pods from helping each other across pods. A nurse explained:

> You hate to be in that pod that’s losing… If one pod is kind of getting killed there isn't a lot of cross-pod help. I feel like, before the pods, somebody was going to help whether they were in your area or not. I feel like, sometimes, now it’s an, “Every pod for themselves,” mentality, like, “Ooh, that sucks that you guys have three sick ones. I’m going to go take care of my ankle pain.

The competitive dynamic between pods changed the salient in-group from the role group to the pod: a nurse in Pod 1 worked more cooperatively with the physicians in Pod 1 than nurses in other pods. Note that this dynamic played out between groups of people with constantly changing membership. There was no enduring affiliation for any individual with any given pod to explain the in-group competitive behavior. Each pod’s temporary minimal in-group nonetheless created in-group favoritism. As one attending explained, “It’s pretty natural… if you were playing a pick-up game of any sport, if you picked teams, it might be a different team every day, but people want to come together, bond together, and win.” Additional data from each of these themes are reported in Table 10b.

Table 10a. Mechanisms Related to Small Group Size

Small Group Size	**Data Illustrating Mechanisms**
Ownership	"Pod design solved the ownership problem because with one faculty, one resident in charge… there is built-in ownership." (Nurse) "The best part of it is that you know who is there and you know that all the patients are yours. Nobody else is going to come in and save you. There is nobody else that's going to come see a patient. Anybody who comes to your pod is yours." (Resident) "The pods make everybody responsible for a chunk of the ER, whereas, before it was you pick up the next chart and could go back and forth and kind of cherry pick. Right now, you have your beds, and you have your patients that are assigned to you. Your nurses are assigned. Everybody knows that you have to work and that makes everything more efficient. You cannot hide from the pod." (Attending)
Visibility	"Beforehand there may have been 15 orders, but nobody really… I don't want to say "cared". "Cared" is not the right word. But, if it took you 30 minutes to get a lab, it was fine. If it took you two-and-a-half hours to do the same thing, that was fine, too. There was nobody really monitoring things. There was just this giant stack of orders, and you got to them when you got to them." (Nurse) "The sorting into teams helps some, too… it is helpful to

Table 10a. (Continued) Mechanisms Related to Small Group Size

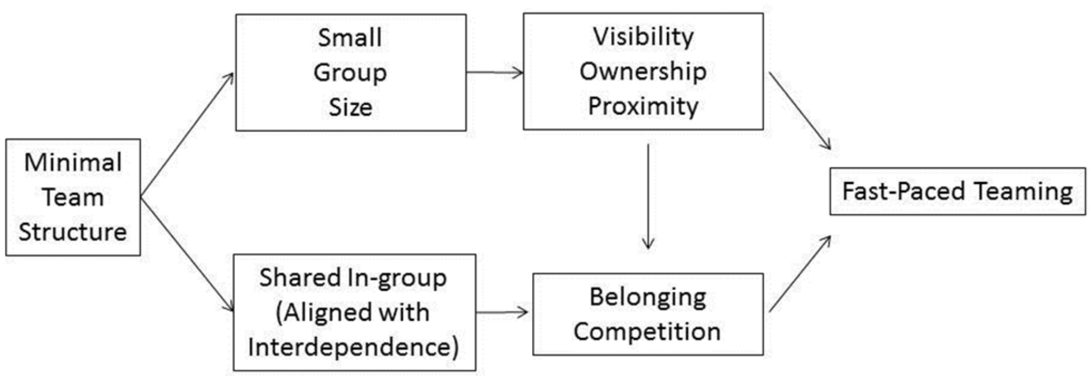
Small Group Size	Data Illustrating Mechanisms
	have your little area to be able to sort of zoom in on." (Nurse) "Now, it's a lot easier to figure out what's going on with 16 beds versus 50 patients on each side of the ER with one supervising nurse who was supposed to know everything—things slipped by a lot easier." (Attending)
Proximity	"You say to yourself, "What's going on [with that patient]?" and then you go to the doctor, who's sitting very close to you and say, "What's going on with this patient?" (Nurse) "The pods put us all in closer physical proximity. That has created an increased comfort factor for approaching physicians. There's cramped quarters with more talking, more opportunity to overhear, more interjecting." (Nurse) "You're all sitting in the same area. Before you might be sitting at one end of the work station and the nurse would be 60-70 feet away. It facilitates a lot more communication when you're all sitting at the same station." (Resident)

Table 10b. Mechanisms Related to Shared In-Group

Shared In-group	Data Illustrating Mechanisms Related to Shared In-group
Belonging	"As people are focused on pod performance, there are moments of collective action. For the most part, I think there is a sense that we're all in this together." (Attending) "People say, 'Our pod is the best pod.'" (Attending) "Now you know who you're with. It really has brought a lot more teamwork home, because you have your own little cohesive unit… [communication] is facilitated because you're in your unit with your people. (Resident)
Competition	"The way the Pods Wars play out is that someone will say "Pod 4 is killing us!" and then the pace and intensity of communication will increase." (Resident) "Before there was much more of a comrade-in-arms attitude among the nurses, with the sense that everyone was getting hammered together so everyone [nurses] came to help. Now your pod may help you, but the other pods won't. If it isn't their pods patient, they have less willingness to help." (Nurse)

In summary, the qualitative data illuminate the social dynamics underlying team scaffolds in this setting. Before the team scaffolds were implemented, people reported not being able to find each other or feeling intimidated or unsure about approaching each other. Nurses and physicians were on opposite sides of a professional divide, asking friends within their profession what a person from another profession with whom they were sharing patients looked like. It had been difficult for people to navigate the social dynamics of coordination without an organized sense of how they belong together. Following the implementation of team scaffolds, people described significant changes in the qualitative experience of working together. The qualitative data provide strong evidence that the team scaffolds supported a kind of pick-up game mentality in the ED. People readily affiliated with the temporary teams – even without on-going relationships – and worked together intensely, even developing a competitive dynamic with other pods. Figure 5 presents a process model illustrating these relationships.

Figure 5. Team Scaffolds, Mechanisms, and Fast-paced Teaming .



CHAPTER 4. FINDINGS: VARIATIONS IN ORGANIZATIONAL STRUCTURE

Chapter 4 reports findings from a cross-case comparison of the pod designs at City, Metro, and Urban Hospitals. Using qualitative interview data, I describe the three different work systems, and compare them on the team scaffold design features identified in the single case study. This analysis reveals significant differences in the pod designs. These differences and further analysis of the qualitative data suggested several themes relating to whether and why the pods felt like meaningful minimal teams.

Pod Design at Metro Hospital

One of the main design features of an team scaffolds identified at City Hospital was the minimal team boundary. At that ED, a counter sectioned off the pod, and also served as the team boundary – whoever was physically inside the pod was assumed to be part of the team at that time. The physicians and nurses both had work stations inside the counter. At Metro Hospital, the pod boundary was not aligned with a team boundary (see Table 11 for additional representative data on each of these design features). Each pod was a distinct room, with hallways separating the A, B, and C pods. For a short time after the redesign, Metro Hospital ED tried to implement teams within the pods, but A and B pod would function with two teams in the same room, and the boundaries between the teams quickly became blurred. The management described it as a mismatch in size – pod A and B could support 1.5 teams, not two, so the team concept did not work. The staff members said that the team concept was not clearly described, designed, or supported, so did not work. Because the team boundary was not effective in communicating who was working together on the team, people relied on the computer system to know with whom they were working. Interviewees described "checking the tile," which was a shape on the computer screen where the patient information and the patient's physician, nurse, and resident/PA were listed. Thus the strong boundary that designated a distinct entity was the room, and the tool for determining partners within that room was the computer system; there was no team boundary making it explicitly clear who was on the team and who was not on the team. People described some difficulty finding and identifying each other in this system because the pods were still fairly large, with many staff members.

The second design feature identified in the City Hospital case was a role set. My interview data suggest that the pods at Metro Hospital functioned similarly to a role structure, in that people had clear understandings of their responsibilities and interdependencies based on their roles, but there was not a cohesive set of roles in the pods. Likely this was influenced by the strong pod boundaries and weak or missing team boundaries. Also, many interviewees described challenges resulting from the staffing patterns. Metro ED was frequently described as a "fat" department, meaning it had many more physicians and nurses than might be expected for the patient volume. Despite the surplus of staff, there seemed to be mismatches between how many nurses and physicians were working in the department at any time. Thus, there was not a consistent complement of roles that could serve as a set. As an example, sometimes the A pod had two attendings (each of whom could work with any resident or nurse in the pod) and sometimes it had one attending, who would work with everyone in the pod.

The third design feature identified in City Hospital was group-level ownership over shared patients. This sense of group-level ownership was neither explicitly designed nor experienced in the Metro ED pods. Instead, there were many mismatched and competing levels of ownership and responsibility. The nurses had what was called "geographic" ownership over different parts of the pods. A nurse would be assigned to a section of beds (usually three beds) and would be responsible for the patients assigned to those beds, but would not have any real ownership beyond those few beds. Residents would choose their patients based on their own availability, and would end up working with several different nurses. The attendings ostensibly had responsibility for the entire pod, but sometimes there was more than one attending in the pod. Beyond these frontline staff members (i.e., those actively treating patients), there were additional levels of hierarchy involved in moving patients through the pod. A nurse-in-charge (NIC) was responsible for keeping track of patients in the pod, and bringing in new patients when beds became available. After the redesign, another layer of hierarchy was added. A new position, called a flow manager, was added to the department, and the flow manager was supposed to be in charge of the flow of patients through the whole ED. Within this whole system, there was not a group that together was held or felt responsible for a set of patients (either in the pod or in the waiting room). Instead, individuals had various levels of ownership, and the patient flow was handled through "increasing levels of hierarchy" (see Table 11).

The final design feature identified at City Hospital was benchmarked performance of the pods. Notably, the same kind of benchmarked performance was in place at Metro Hospital, but it was not used in the same way. At City Hospital, people would use the computer system to look at their own and other pods' patient loads and queues. At Metro Hospital, it was possible to look on the computer system to see the pod's patient load and other pod's patient load, but people rarely did this. Other performance metrics were collected and reported, but only for the attendings. The nurses were never benchmarked on throughput time, either individual or group. Residents were evaluated as part of their education, but not on ED throughput. Attendings were benchmarked on their *individual* throughput time. And finally, after the flow managers were added, they were also held accountable for the overall throughput of patients through the department.

In summary, the pods at Metro ED looked and functioned very differently from the pods at City ED. The pods themselves were more strongly bounded at Metro (a distinct room vs. a counter), but the pod boundary was not aligned with a minimal team boundary (or a role set). There was not a cohesive role set or a sense of group-level ownership. Despite the same real-time group-level performance metrics being available to the Metro ED pods, they were not used in the same way (i.e., to support competition between the pods).

Table 11. Pod design features at Metro Hospital ED

Boundary	"Metro has three separate areas called Alpha, Bravo, and Charlie, they are staffed to be separate and their patients are separate" (Resident) "There's a division [between the pods]. If you go over it's like, "What are you doing here?" It's like you're invading their privacy. You're invading their space." (Nurse)

Table 11. (Continued) Pod design features at Metro Hospital ED

	"Most of the time I know who the clinician's going to be [on one of my patients] because they're pretty good about signing in their patients [by putting their name in the computer system next to the patient]." (Nurse) "One of the biggest challenges [of communicating with the nurses] is knowing who they are and finding them. All you can see is the name of the nurse on the patient tile and the name does not tell you who the face is. I am not going to like walk around in a circle trying to find out who Jennifer is. They are busy, too. They are in all sorts of other rooms and you cannot go like poking your head in every room to tell them [something]." (Resident)
Role Set	"It is a system [where] everybody knows what they are supposed to be doing. They know their roles." (Resident) "We often have more physicians than nurses or we have more nurses than physicians at certain times of day and we can't seem to match the numbers so we have the ability to care for everyone equally on both disciplines." (Nurse)
Group-level Ownership	"I think responsibility for how the patients flow in the pod is

Table 11. (Continued) Pod design features at Metro Hospital ED

	shared between the NIC [nurse in charge] and the attending. Sometimes the residents get involved in that." (Attending) "There is a hierarchical decision-making about patient flow in the pod between the flow manager and the NIC (nurse in charge) and everybody who is in that step-wise decision-making tree. And there have been increasing layers of who the decision person is about where people are going. The increasing complexity seems to actually work against prompt communication with the people who are directly taking care of patients. In the past I think there was just an overall nurse in charge who sort of kept on top of everything, so you could just go to that one person and say, "Right now, I look at the waiting room and I can take these people in, given the space and the capacity that I have." I have gone to the charge nurse, who is on one side in a pod, and said, "I can help move these people in," and I have been told, "Well, it's up to the triage nurse and the flow manager what they're doing." So I recognize that there is someone who is at the ultimate top who is sort of looking over all of the pods, but sometimes it seems as though the level of communication has become increasingly complex so that there is time wasted when there is open capacity." (Attending)

Table 11. (Continued) Pod design features at Metro Hospital ED

Benchmarked Performance	"We [as attendings] get performance feedback on our throughput time. And we do evaluations of the residents; that is part of the residency training requirements. I try really hard to be among the fastest doctors. I have been at it the longest and there is a lot of stuff I can leave out and a lot of short cuts I can take that people do not do when they have just joined the faculty. One of the pushes in this has been to try to decrease the dwell time and get patients through the emergency department faster. Getting feedback on how you do compared to everyone else is very effective." (Attending) "The staff and charge nurses, the NICs, we are basing what we do on patient care related issues. Like, is this good for the department? Meaning, all the bodies in it including the patients and staff and is this also good for patient care? Is this a good thing that we are doing by making them wait an hour before they come in or should they come in right away? There is no measure of that, whereas, physicians have numbers and graphs that they can look at." (Nurse)

Pod Design at Urban Hospital

The pod system at Urban Hospital was also comprised of pods that were distinct rooms (see Table 12 for representative data for each design feature described in this section). Each pod was a large room with a different color scheme, and all of the signs and paperwork and forms matched the pod color scheme. The layout of each pod was roughly the same – there was a large counter in the middle of the room, and patient rooms on the periphery of the room. The physicians sat inside of the counter, and the nurses stood or sat on high stools outside of the counter. Having distinct rooms for the pods was similar to Metro ED, but the pods only ever had one attending, similar to City ED. In this way, it may have seemed like the Urban ED pods had aligned pod boundaries with minimal team boundaries (because there was no potential for two teams in the pod), but there was variation among the interviewees in terms of how much the people in the pods were actually a team. This variation was not seen at City ED. I discuss this in more detail later in the chapter.

Similar to both City and Metro EDs, the Urban ED pods were staffed with a role structure that encoded role responsibilities and interdependencies. The staffing complement was larger in Urban, and the sense of a cohesive role set was not necessarily felt by all staff members. One resident described it as a "hub-and-spoke" model, where the attending was the hub and led many smaller "spoke teams" (made up of the resident and nurse who were working together on any of the pod's patients). There was a sense that effective pod functioning depended on every role doing their role responsibilities well, but it was less clear that the roles functioned as a set.

Ownership was designed and enacted at Urban ED similarly to Metro ED, in that there were many and sometimes mismatched layers of ownership. Similar to the Metro ED nurses, the Urban ED nurses had "geographic" ownership of different sections of the pods. A nurse would have a set number of beds, and his or her responsibility was only the patients on those beds. Nurses would help each other if a patient was coding, but otherwise the focus seemed to be more on their individual beds. The residents had ownership over the set of patients that they chose to see – they felt pressure to see a certain number of patients per hour depending on their year in the program. The attendings were in some ways the owners of the pods (one attending described herself as the "captain" and the pod as her "ship"), but there was a way that this was undermined by a layer of hierarchy above them determining which patients and how many patients were assigned to their pod. There was a patient care coordinator (called the PCC), whose job was a cross between the NICs and the flow manager at Metro. The PCC would assign patients to the pods, and would also watch the flow of patients within each pod to see if there were problems. There was a very clearly bounded group of people in each pod, and yet the sense of group-level ownership was not felt.

Finally, the informal benchmarked performance measures that were used in the "Pod Wars" at City Hospital were available at Urban Hospital, but were not used in the same way. Instead, people said that being able to see other pod's patients made everyone in the pod complain about their own work load, and possibly slow down their efforts because if they worked fast they would be "penalized" with another patient. Attendings were formally assessed on how many patients they saw. Residents reported a sense of being “watched” by the attendings on how many patients they saw, but this was not formally recorded or reported.

Table 12. Pod design features at Urban Hospital ED

Boundary	“[There’s a division]—Blue Pod, Green Pod or Orange Pod. By sectioning it off, you divide up the staff rather than a whole group of people accumulating in one area. To me, people prefer that because people like definition.” (Nurse) “It’s not a problem [to keep track of who you are working with], because even if they’re in another room they’re still within the same area—like the Blue area—so that you can always reach them.” (Nurse)
Role Set	“We know who our Attending is. We know who our nurses are. All the names are listed [on the computer screens].” (Resident) “That’s what makes it work; when the tech does what the tech is supposed to do, when I do my responsibilities appropriately, and also the doctor, every clerk and everybody involved does what they’re supposed to do; then everything goes well, regardless of what comes your way.” (Nurse)

Table 12. (Continued) Pod design features at Urban Hospital ED

Group-level Ownership	"When the patients are put in the rooms [in a specific pod], we have [that list on our computer screen] and it's: these are all the patients that need to be seen. These are the patients accessible to me that I can see right now. We see the patients who are in the pod when they arrive. So if I'm working in the Green pod, unless the patient is in the Green pod, I'm not seeing that patient at all. I have no interaction with that patient." (Resident) "[Patients are] triaged, they're put in the waiting room, and then once we have a bed they assign them to one pod or the other." (Attending)
Benchmarked Performance	"[The management] started doing metrics on how many people [the attendings] are seeing each shift and what level [of acuity] we're seeing each shift." (Attending) "I imagine the attendings are looking at all the Residents, how long the patients have been there, what the chief complaint is." (Resident) "Your name is attached to the patient as your responsibility so you feel more invested in dispositioning the patients.

Table 12. (Continued) Pod design features at Urban Hospital ED

	With your names attached to it, you can see, "Oh, this person is carrying ten patients and this one is carrying two." (Resident)

Table 13 summarizes the differences in pod design at the three hospitals. Despite Metro and Urban both having stronger pod boundaries than City Hospital, there was less a sense of "teamness" reported in the Metro and Urban pods. It was not simply dividing up the ED and establishing a smaller group boundary that allowed City ED pods to function as a team. The other design features served to reinforce and make a team boundary meaningful. These themes are explored more in the rest of the chapter.

Table 13. Comparison of pod design features across three hospital EDs

	City Hospital ED	Metro Hospital ED	Urban Hospital ED
Boundary	Physical boundary is a counter – the pod is encompassed by the counter Team mate boundary reinforced by physical boundary; people easily find each other in the small area ("just	Physical boundary is a room – the pod is the room Team mate boundary not meaningful; people rely on the computer system to know who they are working with on	Physical boundary is a room – the pod is the room Team mate boundary less meaningful; people rely on the computer system to know who they are working with on

Table 13. (Continued) Comparison of pod design features across three hospital EDs

	City Hospital ED	Metro Hospital ED	Urban Hospital ED
	look over")	specific patients	specific patients People have a hard time identifying the techs People think the pods are overbounded
Role Set	Functions like a role set	Functions more like a role structure than a role set • Group size • Multiple attendings in a pod • Lack of alignment in ownership	Functions more like a role structure than a role set • Group size • Lack of alignment in ownership
Group-level Ownership	Pods own patients in the pod beds and also a queue of patients in the waiting room	Pods own only the patients in the pod, more a sense of individual ownership	Pods own only the patients in the pod, more a sense of individual ownership

Table 13. (Continued) Comparison of pod design features across three hospital EDs

		over those patients; patient flow is determined by layers of hierarchy	over those patients; patient flow is determined by one nurse coordinator
Benchmarked Performance	Pod members make use of the computer screen to show how many patients are in their queue compared with other pods; no formal benchmarking during study period	Computer screens do show how other pods are doing, but people do not look to compare performance; attendings are benchmarked separately and formally on throughput time	Computer screens do show how other pods are doing, but people do not look to compare performance; attendings are benchmarked separately and formally on throughput time, residents feel their individual performance (number of patients seen) is watched

The research question that motivated the analysis in this chapter focuses on what the differences in team scaffolds design are, and how they influence how people work together. At City Hospital ED, the pods were set-up with minimal teams that felt meaningful to people – the interviewees referred to them as teams, described group-level coordination processes and group-level competition. Interviewees at the other EDs described effective coordination behaviors enacted in the pods at Metro and Urban, but these were individual behaviors—often people felt a sense of needing to take personal initiative for teamwork to happen, rather than feeling that there was mutual coordination. There was a related sense that the pods were not teams, although most interviewees agreed that teamwork in the pods was important. Despite very similar interview protocols being used at each hospital, the interviews at City Hospital resulted in descriptions of minimal team processes (fast-paced teaming described in Chapter 3) and design features that supported them, whereas the interviews at Metro and Urban Hospital resulted in descriptions of what undermined a sense of teamness among the pods. Two key themes emerged from these descriptions: the way that the work was allocated in each pod system, and where a sense of teamness was actually felt in the ED or the pod. Below I analyze the interview data that support the importance of these two themes. I discuss how these themes show that mismatched and multi-level ownership within groups can undermine a sense of teamness.

Behavioral Responses to Work Allocation

The main difference in how work was allocated to the pods centered on how soon patients belonged to each pod. At City Hospital ED, as soon as a patient was triaged in the waiting room, the patient was assigned to a pod. Thus, the pods would have responsibility for all of the patients who were currently in their pod, and also a queue of patients in the waiting room. The pod could make use of chairs in the hallway adjacent to their pod to bring some of the waiting room patients back for initial assessment, and return them to the waiting room. At Metro and Urban Hospital EDs, patients did not belong to a pod until a bed opened up in the pod (i.e., the patient who was previously on the bed was discharged). Thus, the pods only had responsibility for current patients, and the patients in the waiting room were loosely owned by the entire department.

These represent different solutions for managing the work activities of the ED. Metro and Urban EDs employed a hierarchal solution to ensure that patients flowed efficiently through the department: they created a management position that had authority to move patients into the pods when possible. People occupying these positions were not actually part of the workflow of the pods, so there was asymmetrical information about how soon a patient could actually go to a pod. People describe beds sitting empty at Metro, but not being logged as empty in the computer system, because the nurse who owned that room was not wanting the next patient (for various reasons deemed legitimate or not, depending on who was speaking). At Urban, physicians' assistants (PAs) described "going around" attendings who were moving slowly or avoiding patients by asking the patient care coordinator (PCC) to send more patients to their pod, even if the attending was signaling they were not ready for more patients. A hierarchical solution to patient flow might seem like an efficient solution because someone with authority determines when patients enter pods, but in fact, it became an inefficient system because the flow managers and PCCs were not part of the workflow in the pod and could not adequately monitor what was happening in the pod. The behavioral response was work avoidance by some people in the pod, and work-arounds by other people in the pods. These fragmenting behaviors were exacerbated by the different levels of ownership in the pods. The nurses owned specific beds, and some nurses had a sense that if they worked harder, they would be penalized with more patients in their beds. Because they were the only ones with ownership over the specific beds, it was difficult for others to monitor or help move patients along if the nurse was moving slowly to avoid work. Additional data illustrating the work allocation processes and behavioral responses at Metro and Urban EDs are provided in Table 14.

In contrast, City's solution to patient flow was to give the challenges of managing patient flow directly to the pod teams. Each pod was assigned patients according to the order that the patients arrived in the ED. Each pod owned a queue of patients in the waiting room and it was up to the team to figure out when to bring the next patient from their queue back into the pod. The behavioral response to this work allocation process is part of what made the pods into teams. They had to be aware of what was happening with everyone else in the pod, and they would monitor and help each other so that the whole queue of patients would move. The pods would more actively move patients between the pod, the hallway chairs, and the waiting room as part of this process. People described being very stressed and pressured by this process, but it was also very motivating and required constant group-level coordination.

Table 14. Comparison of work allocation processes and behavioral responses

ED	Work allocation process	Responses
Metro	"Generally, patients are brought in and they are placed in a room. The way that you find out that a patient comes into the pod is either by visually seeing them come in or seeing their tile appear on the computer. I would say usually it is seeing their title and tracker. Or maybe the charge nurse or the flow manager gives you a verbal heads up if a particularly ill patient was brought in." (Attending) "When the nurses were controlling everybody who came back [before the redesign], you felt like it was almost obstructive sometimes. You have four empty rooms yet no patients are coming back. I think the idea with this was that the flow manager is the one who is sending	"I had the capacity to be able to take in more patients who might be simple and put them in the hallway and to be able to take care of them. I tried to communicate that to the charge nurse in that area of the department, and the nurses that I was working with said that they could take a couple of people in. So the lack of someone looking globally at what could happen in one area of one room, in one pod, seemed to limit what I was able to do further." (Attending) "So it gets frustrating when the flow managers are trying to come in and try to push patients onto you, so we'll say, "Well, we've got two ICU patients, two nurses at lunch, there's no resource nurse on today; we're not taking anybody." (Nurse)

Table 14. (Continued) Comparison of work allocation processes and behavioral responses

	the patients, and the lead nurse in that unit needs to make that unit work and use the resources and let them know if they need more resources. I think that idea is a good one, that there is somebody different who is moving people in, and then there is another person who is taking care of it. There is no conflict of interest there, in terms of work." (Attending)	"I feel like they [flow managers] just don't get the reality of our work… They're all "Get the patients in – get the patients in." I'll give you an example of why this doesn't work. We have some regular homeless street people that come in. We know them very well. The other night, we were absolutely slammed and the flow manager wanted us absolutely right this minute to bring one of those people in. There was no need for it; he probably would have gone to sleep. In fact, so we brought him in, that's what we were told to do. He creates this huge scene; the attending physician came out to triage and said "What did you send him in for? You should have let me know and I would have come out to see him right here." And we would have discharged him

Table 14. (Continued) Comparison of work allocation processes and behavioral responses

		right there. So that's just process over reality. It was the wrong thing at the wrong time and [the flow manager] can't always be so cut and dried. Just because there's a bed doesn't mean it's a safe place to put somebody because of what else might be going on." (Nurse)
Urban	"When a patient shows up at the waiting room, they're not assigned to a pod until a bed opens up. There's not like an orange waiting room, a blue waiting room, and a green waiting room. You're not responsible for this whole queue of people until you're ready for the next one." (Attending) "Generally it's the Charge Nurse who's responsible for patient flow.	"I think we all have the tendency to look to see if you're not getting dumped on—that if some other pod is not working as efficiently as they can, if they're not moving the patients, then all of a sudden you're having a higher volume of work just because you're being penalized for being better." (Attending) "A lot of staff are block-oriented—They don't want more than they can

Table 14. (Continued) Comparison of work allocation processes and behavioral responses

	She interacts with the PAs and doctors and says, "Can we dispo these patients?" She might call bed board and asked for beds to be assigned. That requires pushing them to clean beds and make beds available. A lot of times the bed is actually available physically but they can't send the patient up because the bed is either not cleaned or there's no nursing staff on the floor." (PA)	handle with their block. You can't ask them more." (Nurse) "Seeing patients faster means that more beds are going to be opened and it means that you get penalized for seeing more patients because they send more. You send some home and you send some upstairs, and they send you more patients. There are some who might stall sending patients out." (PA) "There is no competition between the pods. There are people trying to stop seeing patients in their pod and dump them on my pod. That's usually my experience." (Attending) "You have no motivation to drive your pod faster. Actually, some

Table 14. (Continued) Comparison of work allocation processes and behavioral responses

		people have figured out a trick. If you move your pod slowly, they can't put new patients in and you wind up seeing less." (Attending) "There is a feeling that the charge nurse is not being fair to the pods. The charge nurse is dumping. And that leads to resentment. That's why a lot of people are resentful of the ED staffing and administration because there is a feeling that it's out of our control. I know Attendings who will watch the board to make sure they're being divided evenly and then get up and go to the Charge Nurse and say, "You just sent three to us. Why?" (PA)

Groupings Described as Meaningful Teams

The second theme that emerged during analysis of the interivews at Metro and Urban Hospitals was the different conditions under which people felt like a team with a group of people. Typically, it was not aligned with pod membership. Table 15a and 15b report representative data illustrating the conditions under which people felt like a team at Metro and Urban Hospital EDs, respectively. At both EDs, the role groups provided a strong sense of teamness. The nurses felt that they worked together as a team, as did the PAs. The residents and attendings would group themselves together as "the medical team" during many interviews. At both EDs, people also identified treating trauma patients as being an example of working together as a team – everyone would be in the room together, working furiously to save one patient, and the actions and efforts seemed well aligned and orchestrated. Both EDs also had examples of clinical areas that functioned as teams before the redesigns – the ECNU (emergency cardiac neuro unit) area at Metro and the Northwest area at Urban. Both of these areas were physically small, with a small and bounded set of providers who shared all the patients in the unit in common. These were both commonly mentioned as good examples of working as a team. Many interviewees at Urban ED also talked about feeling like a team with people who consistently worked the same shift with them. The night shift felt like a team, and certain nurses on a mid-day shift felt like a team. There were no substantive discussions of groupings that formed because of shifts at Metro Hospital.

People gave mixed responses about whether the pods felt like a team. The answer was almost uniformly no at Metro Hospital, although some people said yes, citing the fact that all skill sets were needed for the pod to run smoothly. There was more variation in the responses at Urban Hospital. The residents were the group most likely to identify the pod as a team, and the nurses, PAs, and attendings were less likely to make that connection.

Table 15a. Groupings that were described as meaningful at Metro Hospital ED

Within Pods	"I do not think the pods feel like teams. For example, Charlie is an easy example just because it feels the most like a team. I think there is some of the natural feeling of being a team with the fourth year resident because of teaching the resident how to run a unit. But I do not get that sense amongst the pod as a whole, if you are including nursing staff and the ESAs (techs) and things like that." (Attending) (Describing the brief phase when the management divided the pods into two explicitly bounded teams): "I liked the teams because you knew exactly who you were working with. And the nurses and the PAs or residents knew exactly who to go to for questions. You knew what section of the pod you were responsible for. It was just easier to have your own little fiefdom." (Attending) (Describing a previous area in the ED) "I think we had a model

Table 15a. (Continued) Groupings that were described as meaningful at Metro Hospital ED

Within Pods	for team-based care, or at least an area that really worked well with it and we had this, it's called the ECNU (Emergency Cardiac Neuro Unit) and it was unique in the sense that it was a sort of small area of five regular hospital beds and four fast track or three fast track rooms, and so it was one attending, two senior resident, and two nurses. It was a very small space so like literally, all your docs and all your nurses had all the patients, and so it was very easy to communicate, boom, boom, boom." (Nurse) "There is no team in the pod" (Nurse) "One of the best ways I can think of us working as a true team, having multiple different care providers in the room to support the patient." (Attending) "I feel like we all, like I'll have my own patients, and a nurse has her own patients, and attending has their own patients. If it's like a sick patient, that's when I feel like the teamwork is more important because then we get other PA's involved and other nurses are all involved, and that's when I feel like it's more teamwork because we all like help each other out." (PA)

Table 15a. (Continued) Groupings that were described as meaningful at Metro Hospital ED

Within Shifts	(only brief mention by one interviewee of night shift being more cohesive because there are fewer people, fewer administrators, and patients)
Within Role Groups	"Sure, we're a team. The whole team is the attendings, residents, and medical students." (Resident) "I think the nurses very much work as a team with the other nurses. I feel very strongly that the nurses are excellent at helping each other and I would never hesitate to ask for help. I think it's a little more challenging when you throw the physicians into the mix. I think sometimes it's like two halves of a whole. We are all trying to go to the same place but we are not all going there together. I think there's room for some improvement there." (Nurse)

Table 15b. Groupings that were described as meaningful at Urban Hospital ED

Within Pods	"[The pod] is supposed to be a team between the nurses and the doctors working in there, but the individual nurse has their own patients. It's not like two nurses are sharing the same patients, because you have your block [of beds] and I have my block. So it's not like the two of you have to take care of this patient together. You have yours, and she has hers." (Nurse) "I don't think people in the pod focus on the pod as a whole. You're so worried about your own area that it's unusual to be concerned about someone else's area" (Nurse) "The pod team is everybody, including the PCAs, (Patient Care Assistants or techs), the volunteers, the nurses, the clerks. Even the clerks." (Resident)
Within Shifts	"So the people who work [the noon shift] with me… we all tend to support one another. So if I'm in the trauma room, for example, and I've got a patient crashing, I know that someone would be there to say, "Can I help you," or, "…get this, or get that?" But as for the other shifts, like the day shifts, they might have a totally different thing. We're not really set in a ways that it's, "This is

Table 15b. (Continued) Groupings that were described as meaningful at Urban Hospital ED

	mine, and that's yours." This is for my shift. The people who come in at noon, we tend to help each other out." (Nurse) "The night shift is like family, more than the day shift. If anyone is sick, if anyone doesn't feel well or something and they need their sick day, you'll work for them and they'll work for you. It's just that you always try to help out." (Nurse) "They all got a night team jacket. All the night shift people who work together got those jackets. There are certain attendings and nurses who work nights a lot so there is this team that works nights." (Resident) "My night shift pod is like a team. My nurses and I are very tight. Everybody else is just a rotate. They come, and they go. But me and my nurses know how we're going to run things. It has a lot of that has to do with the stability of the group, because I'm consistently with the same nurses, the same PCAs, the same secretaries, the same cleaning people—the same everything. They all know me, and I know all them. That's kind of the group behind the Night Shift jackets." (Attending)

Table 15b. (Continued) Groupings that were described as meaningful at Urban Hospital ED

Within Role Groups	"Because [the orange pods] is all PAs (physicians assistants) we work well together, because we're all PAs. So that's our group, that's our thing. And we care for one another. I think it runs smoothly just because we look out for one another. We make sure everybody gets their break and make sure that, when they're running ragged, we try to help one another. It's a different relationship than when you're working with Residents or Attendings. I think the PAs tend to look out for each other more, maybe because we're more colleagues than we are with Attendings and Residents." (PA) "I feel like the trauma nurse and the break nurse is a team. If that team works well, then the Green pod usually works very, very well. If that team does not work well, it's a problem." (Nurse)

In summary, the pod structures put in place at Urban and Metro EDs achieved some of the conditions (proximity and boundedness) identified at the first ED as helpful for role-based coordination, but did not scaffold group-level coordination within meaningful team scaffolds. Instead, interviewees referenced other informal groupings that felt like meaningful teams (e.g., the stable group that worked the night shift, those involved in a resusitation, or co-located nurses helping each other). People associate teamness with those aligned with and helping with their interests. The way that work was allocated at the two comparative EDs created a misalignment of ownership and interests between nurses and physicians, which undermined the sense that those working together in a pod were in fact a minimal team.

CHAPTER 5. FINDINGS: ORGANIZATIONAL STRUCTURE AND PERFORMANCE

Emergency department (ED) pods are self-contained sociotechnical work systems (Emery & Trist, 1969). The work of the system is to provide emergency care to patients, which involves stabilizing them and moving them to the appropriate location for follow-up care (i.e., home or admission to the hospital). Patient flow is variable and uncertain: the volume and acuity of patients varies hourly, and the ED has to maintain operations that can immediately respond to critical patients, and can also provide non-urgent care to the many patients who also seek care in the ED. Because of these operational demands, the quality and timeliness of processing patients is critically important. Yet there are no best – or at least standard – practices recognized or implemented in terms of the physical lay-out, staffing patterns, or work flows of these pod systems. In this chapter, I analyze the performance of the ten distinct pods operating at my three field sites, and test the relationship between two types of experience (accumulated experience over time and experience within shift) on pod performance.

Each pod is a stable physical structure with set physical lay-out and design. The physical lay-out and design of work is known to influence people's interactions and productivity (Neumann, Winkel, Medbo, Magneberg, & Mathiassen, 2006). Each pod also has a relatively stable composition of human resources, in terms of the number of physcians, nurses, and techs that staff the pod. Adequate staffing significantly influences the performance of larger medical units (Amaravadi, Dimick, Pronovost, & Lipsett, 2000; Archibald, Manning, Bell, Banerjee, & Jarvis, 1997). Within each pod – constrained and influenced by these more stable factors – unfolds a social coordinative system, wherein fluid groups of individual providers interact to carry out their individual and shared work activities (Barley & Kunda, 2001; Emery & Trist, 1969).

My aim in this chapter is to analyze differences in pod staffing, coordination and performance. I first richly describe each of the ten pods across these various levels – physical lay-out, typical human resources, coordination patterns, and performance. I next report variables that influence pod performance within each hospital, looking for patterns and variation within single EDs. Finally, to identify factors that more generally influence pod performance, I report variables that are associated with pod performance across my field sites, controlling for pod and hospital fixed effects. In this final analysis, I test hypotheses 4 and 5, that predict that accumulated experience working together over time and experience within a shift are associated with pod performance.

Descriptive Statistics of the ED Pods at City, Metro, and Urban Hospitals

In the first analysis, I report descriptive statistics for each of the ten pods across the three field sites.

Pods 1 through 4 at City Hospital ED

Figures 16a-16d depict the pod lay-out and a typical coordination pattern in the pod. As described in the qualitative data, City Hospital put significant emphasis on reducing variation between its four pods. Each pod is supposed to be staffed with the same complement of providers and to see the same level of patient acuity. This focus on low variation is reflected in the descriptive statistics for the City Hospital pods (see Tables 16a-16d). There is very little difference in performance between the pods. Each pod has an average throughput time of about six hours (6.3, 6.7, 6.5, 6.1; $p<0.05$), with no signicant difference in quality (bounceback rate is 5%, 6%, 5%, 6%; $p=0.11$). Pod four sees fewer patients on average during a 24-hour period (53 compared with between 62-66 in the other pods) because it does not stay open for the full 24-hour period like the other pods. Staffing ratios are the same across pods. Differences between pods in coordination patterns are signficant, but small in magnitude. For example, the attending ego size in each pod is 6.7, 6.6., 6.5, and 6.3. This means that in each pod, an attending will likely coordinate with six or seven other providers over the course of a shift. Nurses work with on average four other providers, and resident with four or five other providers. These numbers reflect the formally designed staff complement of the pods (one attending, two residents, and three nurses). Attendings can work with one of two residents and one of three nurses on each patient. Nurses can work with the one attending, and one of two residents. Experience working together over time is around five. This means that on average, each dyad in the pod worked together in the same pod five times in the 90 days prior to the focal shift. Shared patients within shift is around three in each pod. This means that of the providers that shared patients, they worked together on about three patients during the course of the shift.

Figure 6a. Lay-out and coordination pattern, Pod 1, City Hospital

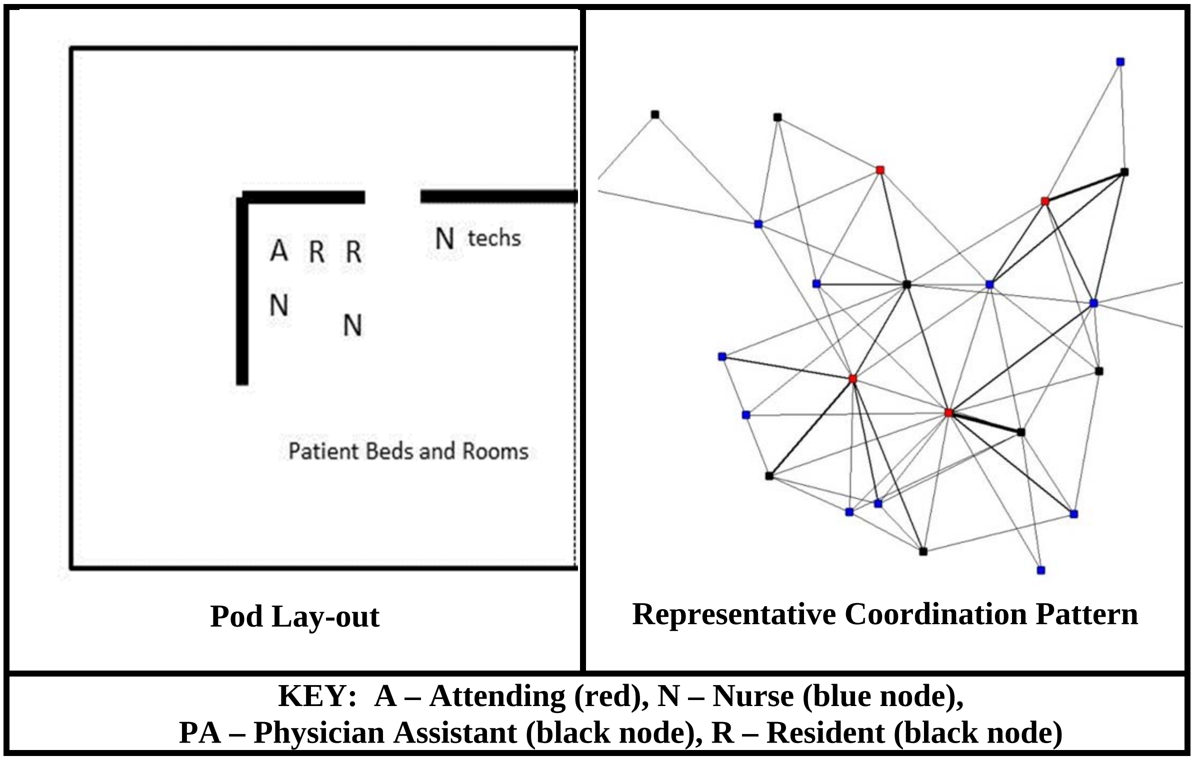
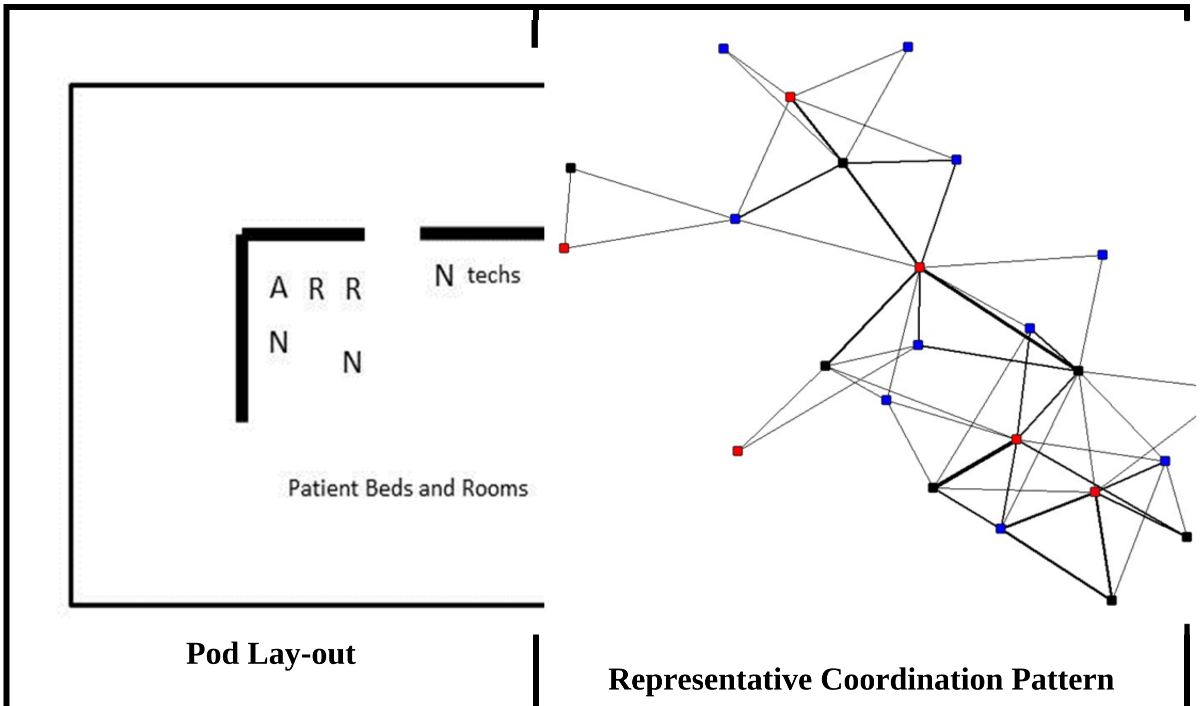


Table 16a. Descriptive Statistics for Pod 1, City Hospital

Performance		
Average Throughput Time (Hours)	**6.3** (1.2)	
Average Bounceback (%)	0.06 (0.03)	
Average Number of Patients Seen	**67.2** (10.6)	
Resources		
Attendings number, per patient	5	0.07 (0.02)
Residents/PAs number, per patient	7	**0.1** (0.03)
Nurses number, per patient	13	0.2 (0.03)
Relational		
Group Familiarity (presence in pod)	**4.7** (1.2)	
Group Familiarity (weight of ties)	**5.9** (2.0)	
Shared Patients (weight of ties)	**2.7** (0.4)	
Attending Number of Partners (ego size)	**6.7** (1.3)	
Nurse Number of Partners (ego size)	**3.8** (0.5)	
Resident/PA Number of Partners (ego size)	**5.1** (0.8)	
Individual		
Experience in ED	23.7 (5.7)	
Experience in Pod	**9.8 (**2.6)	

Bolded values indicate significance difference between pods on this value within this hospital

Figure 6b. Lay-out of Pod 2, City Hospital



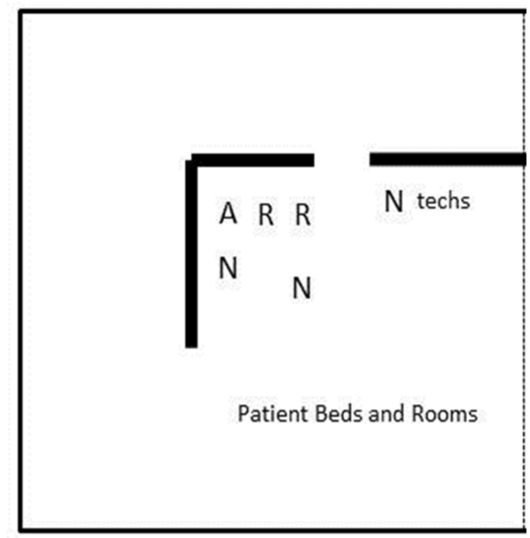
KEY: A – Attending (red), N – Nurse (blue node),
PA – Physician Assistant (black node), R – Resident (black node)

Table 16b. Descriptive Statistics for Pod 2, City Hospital

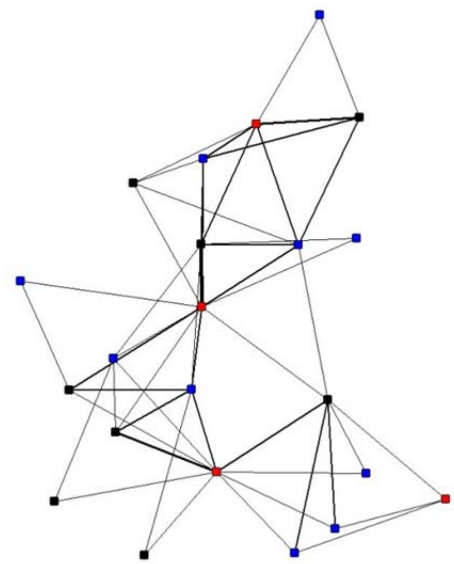
Performance		
Average Throughput Time (Hours)	**6.7** (1.4)	
Average Bounceback (%)	0.05 (0.03)	
Average Number of Patients Seen	**66.6 (**10.4)	
Resources		
Attendings number, per patient	5	0.08 (0.02)
Residents/PAs number, per patient	7	**0.1** (0.03)
Nurses number, per patient	13	0.2 (0.07)
Relational		
Group Familiarity (presence in pod)	**4.3** (1.3)	
Group Familiarity (weight of ties)	**4.8** (1.7)	
Shared Patients (weight of ties)	**2.6** (0.4)	
Attending Number of Partners (ego size)	**6.6** (1.3)	
Nurse Number of Partners (ego size)	**3.9** (0.6)	
Resident/PA Number of Partners (ego size)	**4.8** (0.7)	
Individual		
Experience in ED	22.7 (5.5)	
Experience in Pod	**9.3** (2.3)	

Bolded values indicate significance difference between pods on this value within this hospital

Figure 6c. Lay-out of Pod 3, City Hospital



Pod Lay-out



Representative Coordination Pattern

KEY: A – Attending (red), N – Nurse (blue node),
PA – Physician Assistant (black node), R – Resident (black node)

Table 16c. Descriptive Statistics for Pod 3, City Hospital

Performance		
Average Throughput Time (Hours)	**6.5** (1.3)	
Average Bounceback (%)	0.05 (.03)	
Average Number of Patients Seen	**62.2** (10.9)	
Resources		
Attendings number, per patient	5	0.8 (0.02)
Residents/PAs number, per patient	7	**0.1** (0.02)
Nurses number, per patient	13	0.2 (0.04)
Relational		
Group Familiarity (presence in pod)	**4.5** (1.4)	
Group Familiarity (weight of ties)	**5.2** (1.9)	
Shared Patients (weight of ties)	**2.6** (0.4)	
Attending Number of Partners (ego size)	**6.5** (1.2)	
Nurse Number of Partners (ego size)	**3.8** (0.6)	
Resident/PA Number of Partners (ego size)	**4.8** (0.7)	
Individual		
Experience in ED	23.1 (5.6)	
Experience in Pod	**23.4** (5.7)	

Bolded values indicate significance difference between pods on this value within this hospital

Figure 6d. Lay-out of Pod 4, City Hospital

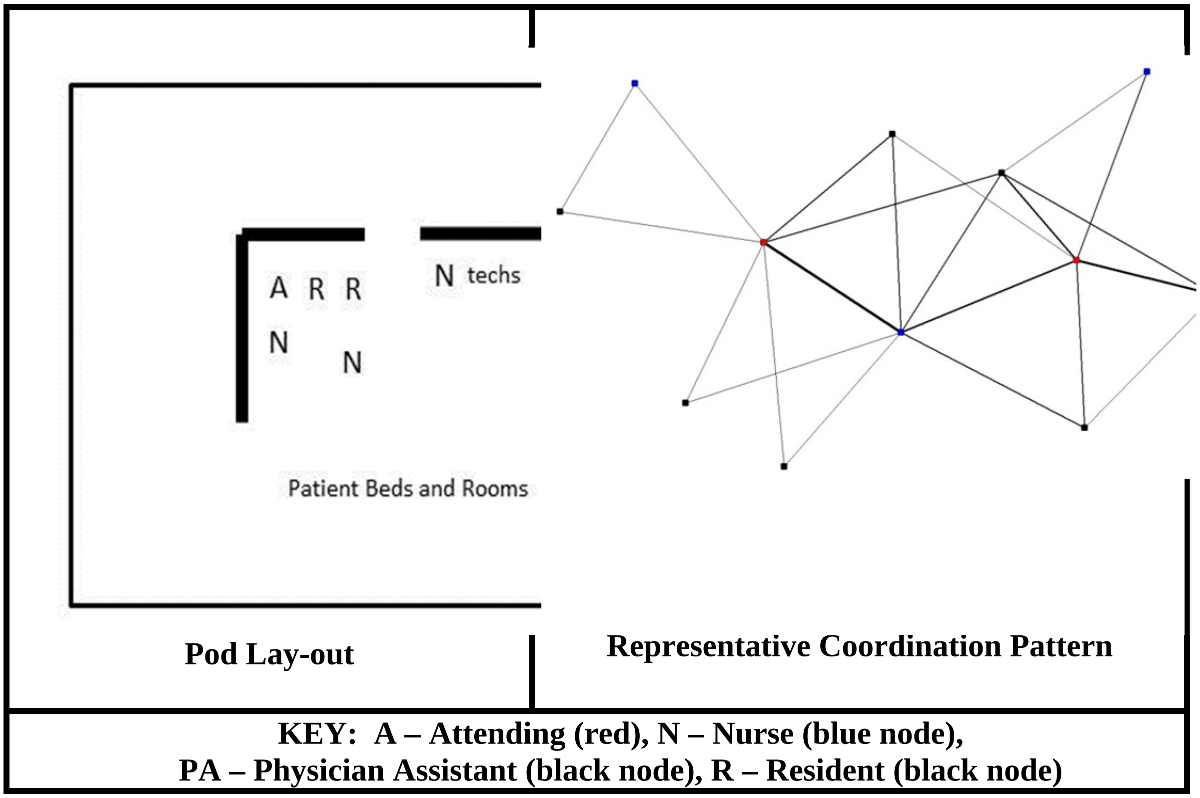


Table 16d. Descriptive Statistics for Pod 4, City Hospital

Performance		
Average Throughput Time (Hours)	**6.1** (1.4)	
Average Bounceback (%)	0.05 (0.03)	
Average Number of Patients Seen	**53.1** (13.9)	
Resources		
Attendings number, per patient	4	0.08 (0.07)
Residents/PAs number, per patient	5	**0.1** (0.07)
Nurses number, per patient	11	0.2 (0.07)
Relational		
Group Familiarity (presence in pod)	**4.6** (1.4)	
Group Familiarity (weight of ties)	**5.3** (2.1)	
Shared Patients (weight of ties)	**3.0** (0.8)	
Attending Number of Partners (ego size)	**6.3** (1.5)	
Nurse Number of Partners (ego size)	**3.6** (0.8)	
Resident/PA Number of Partners (ego size)	**4.6** (0.8)	
Individual		
Experience in ED	23.4 (5.7)	
Experience in Pod	**7.6** (2.1)	

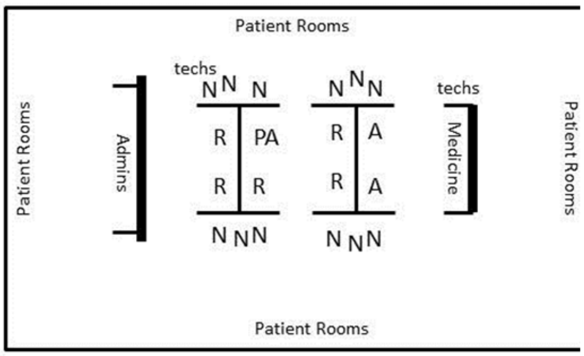
Bolded values indicate significance difference between pods on this value within this hospital

Pods A, B, and C at Metro Hospital ED

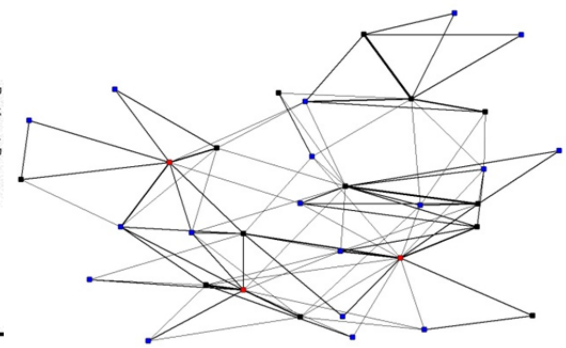
Metro Hospital has three pods. Their redesign focused less on limiting variation between the pods in lay-out, staffing, and patient acuity-level than did City Hospital's redesign. There is significant variation between the pods on all of these characteristics, including performance (see Figures and Tables 16e-16g). The A pod has an average throughput time of about five hours, and B and C have an average throughput time of about four hours. There is no significant difference in quality between the pods. The A pod is a larger physical space than C, has twice the number of staff and sees twice the number of patients. Pod B and C do not stay open for 24-hours a day. The group size in pod A is 46: 6 attendings, 16 residents/PAs, 24 nurses staff pod A during a 24-hour period, on average. Pod B is staffed by 32 people (4 attendings, 11 residents/PAs, and 17 nurses). Pod C is the smallest pod with 23 staff (3 attending, 8 residents/PAs and 12 nurses). Pod C is staffed somewhat similarly to the pods at City Hospital, in that there is one dedicated attending and a dedicated set of nurses. The C pod is slightly larger than the City Hospital pods, however, because there are usually two residents and a physicians assistant (PA) seeing patients (compared with two residents at City). Despite differences in staffing and the number of patients seen, the staff to patient ratio is mostly consistent across the pods, and is in fact similar to the staff to patient ratio at City Hospital.

The coordination patterns differ somewhat across the Metro pods. In pod A, an attending will work with 12 other providers, on average, and about 10 in the C and B pods. The attendings at Metro have a much larger ego size than the attendings at City (which was seven on average), likely because there are so many more residents and nurses in the larger pods with them. The nurses have an ego size of about four in each pod, this is similar to City. And the residents' average ego size is about six in each pod, one more than the residents at City. Relatedly, the average weight of ties is lower at Metro than at City. On average, dyads share two patients within a shift (note this is averaged across all dyads, so certain dyads will have significantly more shared patients). Group familiarity is about four in every pod.

Figure 6e. Lay-out of Pod A, Metro Hospital



Pod Lay-out



Representative Coordination Pattern

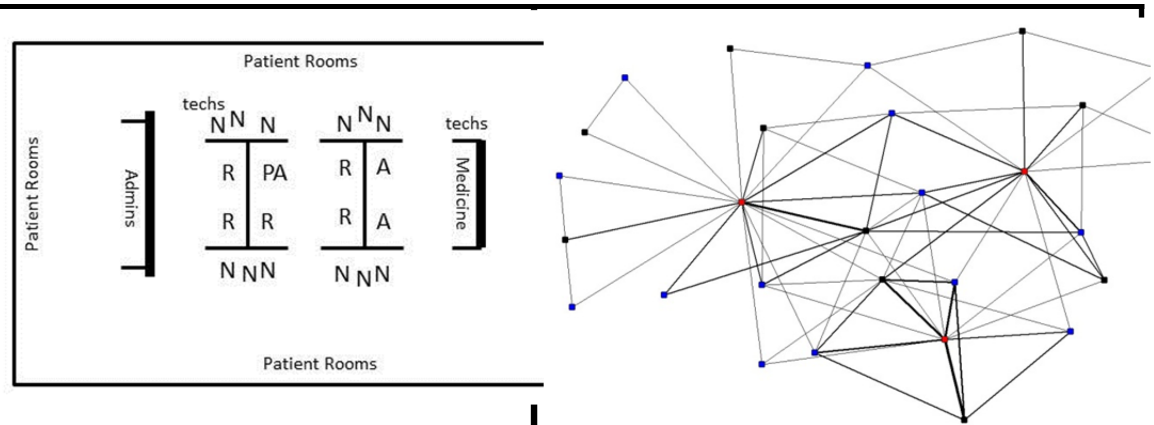
KEY: A – Attending (red), N – Nurse (blue node),
PA – Physician Assistant (black node), R – Resident (black node)

Table 16e. Descriptive Statistics for Pod A, Metro Hospital

Performance	**Mean (SD)**	
Average Throughput Time (Hours)	**4.9** (1.0)	
Average Bounceback (%)	0.03 (0.02)	
Average Number of Patients Seen	**78.7** (10.4)	
Resources		
Attendings number, per patient	6	**0.08** (0.02)
Residents/PAs number, per patient	16	**0.2** (0.03)
Nurses number, per patient	24	**0.3** (0.05)
Relational		
Group Familiarity (presence in pod)	**4.2** (0.8)	
Group Familiarity (weight of ties)	**2.3** (0.6)	
Shared Patients (weight of ties)	**1.5** (0.1)	
Attending Number of Partners (ego size)	**11.5** (2.3)	
Nurse Number of Partners (ego size)	**3.8** (0.4)	
Resident/PA Number of Partners (ego size)	**6.2** (0.9)	
Individual		
Experience in ED	**18.7** (2.8)	
Experience in Pod	**13.5 (**2.0)	

Bolded values indicate significance difference between pods on this value within this hospital

Figure 6f. Lay-out of Pod B, Metro Hospital



Pod Lay-out

Representative Coordination Pattern

KEY: A – Attending (red), N – Nurse (blue node), PA – Physician Assistant (black node), R – Resident (black node)

Table 16f. Descriptive Statistics for Pod B, Metro Hospital

Performance	**Mean (SD)**	
Average Throughput Time (Hours)	**4.0** (0.9)	
Average Bounceback (%)	0.04 (0.03)	
Average Number of Patients Seen	**56.2** (14.3)	
Resources		
Attendings number, per patient	4	**0.07** (0.02)
Residents/PAs number, per patient	11	**0.2** (0.04)
Nurses number, per patient	17	**0.3** (0.05)
Relational		
Group Familiarity (presence in pod)	**4.4** (1.1)	
Group Familiarity (weight of ties)	**2.7** (0.9)	
Shared Patients (weight of ties)	**1.8** (0.3)	
Attending Number of Partners (ego size)	**10.4** (3.1)	
Nurse Number of Partners (ego size)	**3.9** (0.6)	
Resident/PA Number of Partners (ego size)	**6.0** (1.3)	
Individual		
Experience in ED	**19.7** (3.2)	
Experience in Pod	**9.7** (2.3)	

Bolded values indicate significance difference between pods on this value within this hospital

Figure 6g. Lay-out of Pod C, Metro Hospital

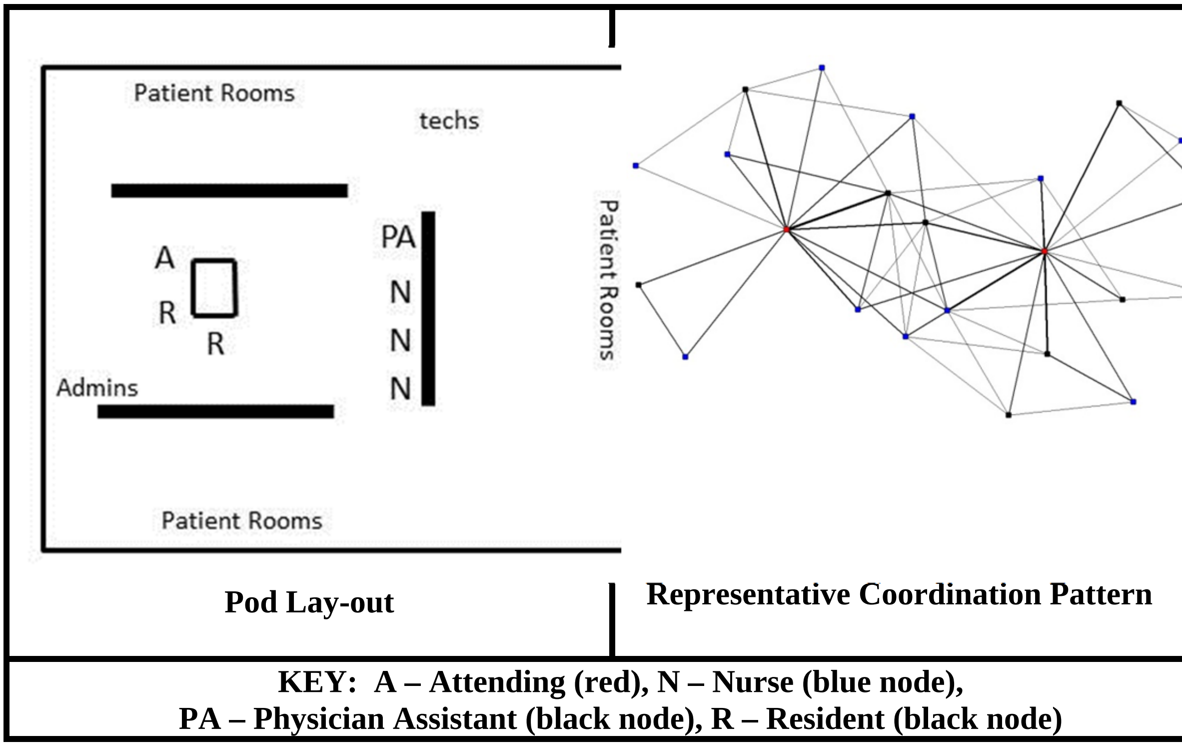


Table 16g. Descriptive Statistics for Pod C, Metro Hospital

Performance	**Mean (SD)**	
Average Throughput Time (Hours)	**3.9** (0.9)	
Average Bounceback (%)	0.04 (0.03)	
Average Number of Patients Seen	**38.6** (7.6)	
Resources		
Attendings number, per patient	3	**0.07** (0.06)
Residents/PAs number, per patient	8	**0.2** (0.05)
Nurses number, per patient	12	**0.3** (0.08)
Relational		
Group Familiarity (presence in pod)	**3.5** (0.8)	
Group Familiarity (weight of ties)	**2.0** (0.7)	
Shared Patients (weight of ties)	**1.8** (0.2)	
Attending Number of Partners (ego size)	**10.5** (2.8)	
Nurse Number of Partners (ego size)	**3.4** (0.5)	
Resident/PA Number of Partners (ego size)	**4.7** (0.8)	
Individual		
Experience in ED	**18.2** (2.2)	
Experience in Pod	**5.5** (1.9)	

Bolded values indicate significance difference between pods on this value within this hospital

Blue, Green, and Orange Pods at Urban Hospital ED

Urban Hospital ED also has three pods. They have more consistency in the physical layout of their pods (see Figures 16h-16j), but differences in how they staff these areas, and in how many patients each pod sees in a 24-hour period. The Blue pod functions as the primary pod, and sees the most patients (117 compared to 89 and 44 in Green and Orange). Some of this difference in patient volume is because Blue stays open 24-hours a day, although a few months after the redesign, the patient volume was so high that Green pod stayed open 24-hours a day as well. There is also signficant difference in operational performance (see Tables 16h-16j). Despite the Blue pod seeing more patients (and reportedly sicker patients), the throughput time is less. Blue pod averages a 4.6 hour throughput time, whereas the Green pod averages a 6 hour throughput time. There is no significant difference in quality between the pods, although their bounceback rate is highest at 6% across all pods. This likely reflects their patient population – the Urban ED is located in the center of a large city sees many indigent patients who suffer from addiction and mental illness and rely on the ED for food and shelter (Newton et al., 2010; Pham et al., 2011). City and Metro EDs have different group sizes across pods, but maintain a consistent staff to patient ratio within the department, whereas Urban ED has significant differences in staffing ratios across pods. Specifically, there are more attendings per patients seen in the blue pod than the green pod (~4 attendings for ~120 patients, compared with ~6 attendings for ~90 patients, respectively).

The coordination patterns also differ significantly across the Urban pods. In the Blue pod, an attending will work with 11 other providers, on average, about 10 in the Green pod and only five in the orange pod. The Blue and Green pod look more like the

A and B pods at Metro, even though they are typically only staffed with one attending at a time rather than two. The nurses' ego size is between three and five, and the residents is between five and seven. The average weight of ties is between two and three. The fluid groups staffing the pods at Urban Hospital are on average more familiar with each other than the fluid groups staffing the pods at City Hospital. Each pair has worked together in a pod six times over the previous 90 days at Urban ED, compared with four at Metro and five at City Hospital.

Figure 6h. Lay-out of Blue Pod, Urban Hospital

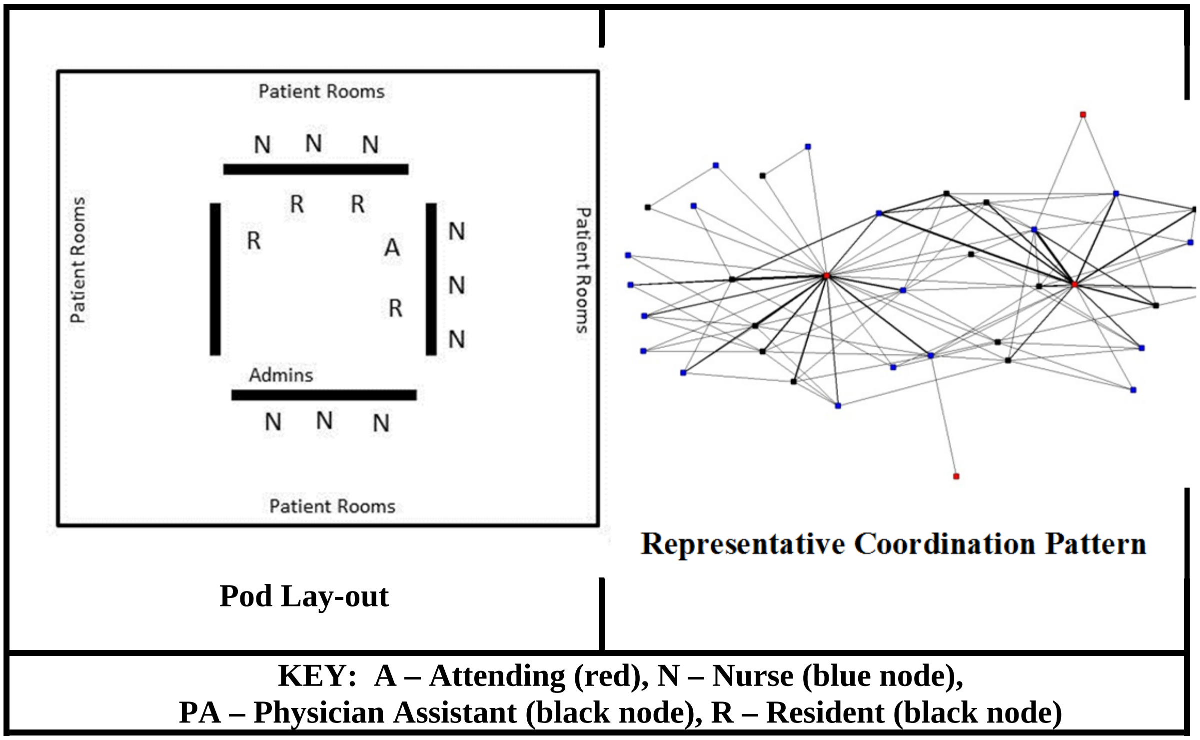
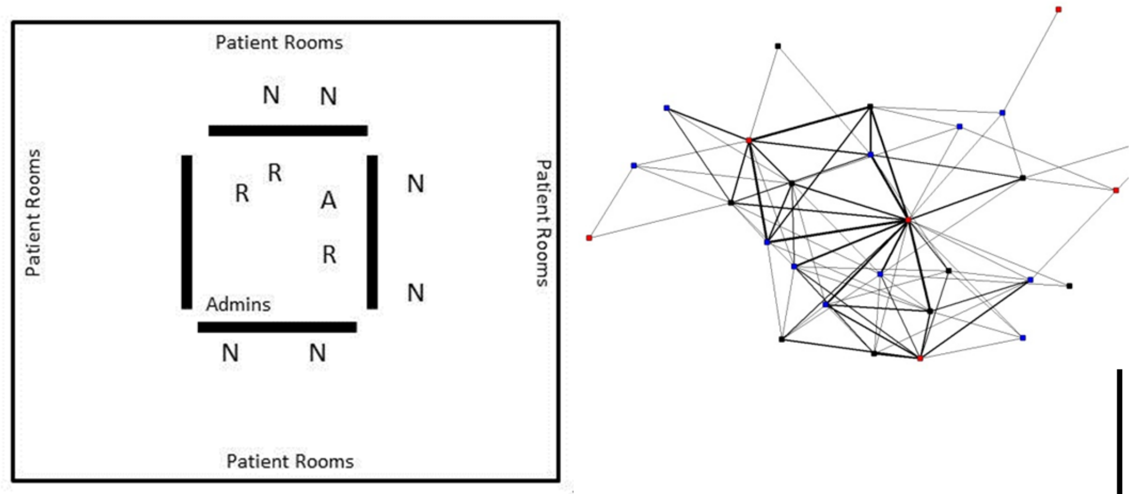


Table 16h. Descriptive Statistics for Blue Pod, Urban Hospital

Performance		
Average Throughput Time (Hours)	**4.6** (0.7)	
Average Bounceback (%)	0.06 (0.02)	
Average Number of Patients Seen	**116.8** (15.1)	
Resources		
Attendings per patient	4	**0.04** (0.01)
Residents/PAs per patient	12	**0.1** (0.02)
Nurses per patient	16	**0.2** (0.02)
Relational		
Group Familiarity (presence in pod)	**6.3** (1.3)	
Group Familiarity (weight of ties)	**8.9** (3.7)	
Shared Patients (weight of ties)	**3.0** (0.4)	
Attending Number of Partners (ego size)	**10.7** (2.9)	
Nurse Number of Partners (ego size)	**4.4** (0.5)	
Resident/PA Number of Partners (ego size)	**5.7** (0.8)	
Individual		
Experience in ED	**21.7** (2.0)	
Experience in Pod	**12.3** (2.7)	

Bolded values indicate significance difference between pods on this value within this hospital

Figure 6i. Lay-out of Green Pod, Urban Hospital



Pod Lay-out | **Representative Coordination Pattern**

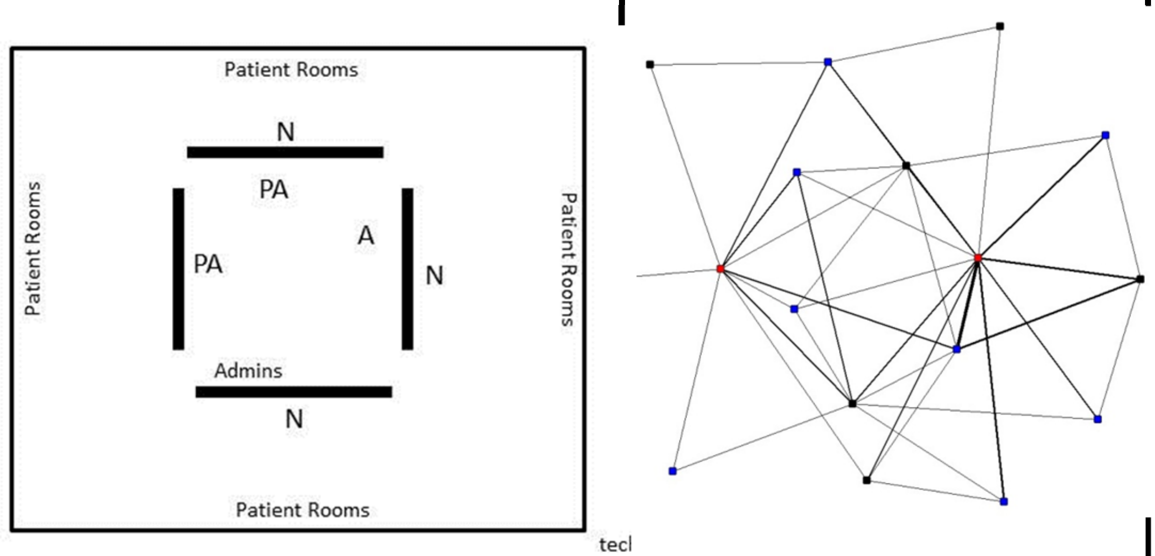
KEY: A – Attending (red), N – Nurse (blue node),
PA – Physician Assistant (black node), R – Resident (black node)

Table 16i. Descriptive Statistics for Green Pod, Urban Hospital

Performance		
Average Throughput Time (Hours)	**5.8** (1.0)	
Average Bounceback (%)	0.06 (0.03)	
Average Number of Patients Seen	**89.2** (19.2)	
Resources		
Attendings per patient	6	**0.07** (0.2)
Residents/PAs per patient	11	**0.1** (0.03)
Nurses per patient	16	**0.2** (0.04)
Relational		
Group Familiarity (presence in pod)	**6.7** (1.8)	
Group Familiarity (weight of ties)	**6.4** (1.7)	
Shared Patients (weight of ties)	**2.1** (0.3)	
Attending Number of Partners (ego size)	**10.0** (2.3)	
Nurse Number of Partners (ego size)	**5.0** (0.8)	
Resident/PA Number of Partners (ego size)	**6.9** (1.1)	
Individual		
Experience in ED	**20.4** (2.2)	
Experience in Pod	**12.9** (3.1)	

Bolded values indicate significance difference between pods on this value within this hospital

Figure 6j. Lay-out of Orange Pod, Urban Hospital



Pod Lay-out

Representative Coordination Pattern

KEY: A – Attending (red), N – Nurse (blue node), PA – Physician Assistant (black node), R – Resident (black node)

Table 16j. Descriptive Statistics for Orange Pod, Urban Hospital

Performance		
Average Throughput Time (Hours)	**4.6** (1.1)	
Average Bounceback (%)	0.06 (0.04)	
Average Number of Patients Seen	**43.6** (15.9)	
Resources		
Attendings per patient	4	**0.1** (0.1)
Residents/PAs per patient	4	**0.1** (0.03)
Nurses per patient	7	**0.2** (0.1)
Relational		
Group Familiarity (presence in pod)	**4.5** (1.8)	
Group Familiarity (weight of ties)	**7.1** (3.5)	
Shared Patients (weight of ties)	**2.8** (0.7)	
Attending Number of Partners (ego size)	**5.3** (1.7)	
Nurse Number of Partners (ego size)	**3.4** (0.7)	
Resident/PA Number of Partners (ego size)	**4.8** (1.4)	
Individual		
Experience in ED	**21.5** (3.6)	
Experience in Pod	**7.5** (2.7)	

Bolded values indicate significance difference between pods on this value within this hospital

Overall, Urban Hospital has the "leanest" pods in terms of the number of providers used to care for the pod's patients. In Urban's blue pod, 32 providers care for 117 patients on average (ratio – 0.27). Metro Hospital has the "fattest" pods – in their main pod, 46 providers care for 79 patients on average (ratio – 0.58). City Hospital is in the middle with a patient to staff ratio of 0.36. City Hospital also has the smallest group size in their pods (25 on average, compared to 32 and 46).

Within Hospital Pod Performance

In the second analysis, I examine the patterns of relationships with pod performance *within* each hospital. The pods are staffed by fluid groups of people (though with slightly more consistency at Urban ED), meaning a new configuration of people works together each 24-hour period within the same unique resource environment of each pod. Both the human resources available in each pod and also the way that the individual providers coordinate their work are likely to influence performance. Note that the unit of analysis is a 24-hour period, with properties of the 24-hour coordination pattern regressed onto the related 24-hour throughput time.

Within hospital pod performance at City Hospital ED

The coefficient values for analyses conducted within each pod in City Hospital ED are reported in Tables 17a-17d. The pattern of results (positive or negative and significance) are detailed in Table 18. The staff ratio predicts pod performance: having more staff per patient reduces throughput time in the City pods. Also, the average weight of ties, or the number of patients shared by each dyad within the pod is also significantly associated with faster throughput time in every pod.

Table 17a. Results of Regression on Throughput Time (Pod 1, City Hospital)

	Model 1	**Model 2**
Resources		
Attendings per patient	-3.2 (3.6)	
Residents/PAs per patient	2.3 (2.5)	
Nurses per patient	3.3 (1.8) +	
Staff per patient		-5.2 (1.6) **
Relational		
Group Familiarity		-0.07 (0.07) +
Shared Patients		-1.2 (0.2) **
Attending Number of Partners		0.07 (0.04) +
Nurse Number of Partners		0.08 (0.11)
Resident Number of Partners		-0.07 (0.07) +
Individual		
Experience in ED		-0.18 (0.03) **

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 17b. Results of Regression on Throughput Time (Pod 2, City Hospital)

	Model 1	**Model 2**
Resources		
Attendings per patient	4.5 (4.3)	
Residents/PAs per patient	6.4 (2.8) *	
Nurses per patient	1.4 (2.1)	
Staff per patient		-6.8 (1.8) **
Relational		
Group Familiarity		0.1 (0.09)
Shared Patients		-1.7 (0.2) **
Attending Number of Partners		0.04 (0.05)
Nurse Number of Partners		0.2 (0.1) +
Resident Number of Partners		-0.2 (0.09) +
Individual		
Experience in ED		-0.12 (0.05) *

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 17c. Results of Regression on Throughput Time (Pod 3, City Hospital)

	Model 1	Model 2
Resources		
Attendings per patient	-0.8 (3.7)	
Residents/PAs per patient	1.9 (2.8)	
Nurses per patient	0.02 (1.8)	
Staff per patient		-8.5 (1.7) **
Relational		
Group Familiarity		0.1 (0.09)
Shared Patients		-1.5 (0.2) **
Attending Number of Partners		0.02 (0.05)
Nurse Number of Partners		-0.05 (0.1)
Resident Number of Partners		-0.08 (0.2)
Individual		
Experience in ED		-0.05 (0.05)

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 17d. Results of Regression on Throughput Time (Pod 4, in City Hospital)

	Model 1	Model 2
Resources		
Attendings per patient	-6.1 (2.5) *	
Residents/PAs per patient	12.9 (2.1) **	
Nurses per patient	-1.8 (1.6)	
Staff per patient		-1.0 (0.4) *
Relational		
Group Familiarity		0.04 (0.06)
Shared Patients		-0.7 (0.09) **
Attending Number of Partners		-0.02 (0.04)
Nurse Number of Partners		0.4 (0.09)
Resident Number of Partners		0.02 (0.07)
Individual		
Experience in ED		-0.02 (0.04)

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 18. Summary of Results from Pods at City Hospital

	Pod 1	Pod 2	Pod 3	Pod 4
Resources				
Staff per patient	-	-	-	-
Relational				
Group Familiarity				
Shared Patients	-	-	-	-
Attending Number of Partners				
Nurse Number of Partners				
Resident Number of Partners				
Individual				
Experience in ED	-	-		

Within hospital pod performance at Metro Hospital ED

The coefficient values for each pod in Metro Hosptial ED are reported in Tables 19a-19c. The pattern of results (positive or negative and significance) are detailed in Table 20. In the two large pods (A and B), the staffing ratios predict faster througput time. Also, properties of the coordination pattern are associated with better performance. The number of shared patients per dyad is associated with faster throughput time. In both of these pods, larger nurse and resident ego networks are also significantly associated with performance. In pod C, the within shift weight of ties and attending and nurse ego size are associated with faster throughput.

Table 19a. Results of Regression on Throughput Time (Pod A, Metro Hospital)

	Model 1	**Model 2**
Resources		
Attendings per patient	-6.7 (1.6)	
Residents/PAs per patient	-5.3 (1.0) **	
Nurses per patient	8.4 (0.7) **	
Staff per patient		-8.1 (0.8) **
Relational		
Group Familiarity		-0.005 (0.08)
Shared Patients		-5.5 (0.4) **
Attending Number of Partners		0.03 (0.01) *
Nurse Number of Partners		-1.1 (0.1) **
Resident Number of Partners		-0.3 (0.04) **
Individual		
Experience in ED		-0.06 (0.03)

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 19b. Results of Regression on Throughput Time (Pod B, Metro Hospital)

	Model 1	Model 2
Resources		
Attendings per patient	10.1 (1.1) **	
Residents/PAs per patient	1.2 (.8)	
Nurses per patient	0.8 (0.6)	
		-2.6 (0.7) **
Relational		
Group Familiarity		-0.1 (0.04) **
Shared Patients		-1.0 (0.2) **
Attending Number of Partners		-0.06 (0.01) **
Nurse Number of Partners		-0.4 (0.7) **
Resident Number of Partners		-0.2 (0.03) *
Individual		
Experience in ED		0.07 (0.02) *

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 19c. Results of Regression on Throughput Time (Pod C, Metro Hospital)

	Model 1	Model 2
Resources		
Attendings per patient	2.2 (1.1) +	
Residents/PAs per patient	-2.2 (1.4)	
Nurses per patient	3.2 (1.0) **	
Staff ratio		-1.2 (0.8) +
Relational		
Group Familiarity		-0.001 (0.08)
Shared Patients		-0.7 (0.3) **
Attending Number of Partners		-0.09 (0.02) **
Nurse Number of Partners		-0.5 (0.2) **
Resident Number of Partners		-0.1 (0.08) +
Individual		
Experience in ED		0.02 (0.03)

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 20. Summary of Results from Pods at Metro Hospital

	Pod A	Pod B	Pod C
Resources			
Staff per patient	-	-	
Relational			
Group Familiarity		-	
Shared Patients	-	-	-
Attending Number of Partners	+	-	-
Nurse Number of Partners	-	-	-
Resident Number of Partners	-	-	
Individual			
Experience in ED		+	

Within hospital pod performance at Urban Hospital ED

The coefficient values for each pod in Urban Hosptial ED are reported in Tables 21a-21c. The pattern of results (positive or negative and significance) are detailed in Table 22. Blue pod is the pod with the most patients per staff of any of the pods at any ED. In this pod, the staff ratio is significantly related to throughput time, but properties of the coordination pattern are not. In the green pod, which has a high staff ratio, number of shared patients and ego size for all providers was signficant. In the orange pod, both staff ratio and properties of the coordination pattern were significant. There was not a consistent pattern in relationships across the pods at Urban Hospital ED.

Table 21a. Results of Regression on Throughput Time (Blue Pod, Urban Hospital)

	Model 1	**Model 2**
Resources		
Attendings per patient	-3.4 (2.3)	
Residents/PAs per patient	-1.8 (1.6)	
Nurses per patient	-1.3 (1.3)	
Staff per patient		-3.4 (1.4) *
Relational		
Group Familiarity		0.07 (0.04) +
Shared Patients		-0.2 (0.1) +
Attending Number of Partners		-0.0001 (0.02)
Nurse Number of Partners		0.01 (0.1)
Resident Number of Partners		-0.01 (0.01)
Individual		
Experience in ED		0.03 (0.01) *

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 21b. Results of Regression on Throughput Time (Green Pod, Urban Hospital)

	Model 1	Model 2
Resources		
Attendings per patient	3.5 (2.2)	
Residents/PAs per patient	0.08 (1.5)	
Nurses per patient	4.6 (1.2) **	
Staff per patient		-2.1 (1.2)
Relational		
Group Familiarity		-0.03 (0.5)
Shared Patients		-0.5 (0.3) *
Attending Number of Partners		-0.06 (0.02) **
Nurse Number of Partners		-0.3 (0.06) **
Resident Number of Partners		-0.2 (0.04) **
Individual		
Experience in ED		0.001 (0.001)

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 21c. Results of Regression on Throughput Time (Orange Pod, Urban Hospital)

	Model 1	Model 2
Resources		
Attendings per patient	1.2 (0.9)	
Residents/PAs per patient	1.0 (0.8)	
Nurses per patient	-0.7 (0.7)	
Staff per patient		-0.6 (0.3) *
Relational		
Group Familiarity		0.07 (0.03) *
Shared Patients		-0.4 (0.07) **
Attending Number of Partners		0.02 (0.03)
Nurse Number of Partners		-0.06 (0.05)
Resident Number of Partners		-0.17 (0.03) **
Individual		
Experience in ED		0.01 (0.01)

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 22. Summary of Results from Pods at Urban Hospital

	Blue Pod	Green Pod	Orange Pod
Resources			
Staff per patient	-		-
Relational			
Group Familiarity			+
Shared Patients		-	-
Attending Number of Partners		-	
Nurse Number of Partners		-	
Resident Number of Partners		-	-
Individual			
Experience in ED			

Across Hospital Pod Performance

In this section, I report results from a multi-level analysis that considers the performance of the coordination networks nested in pods, which are nested in hospitals. Such an analysis explores factors that influence pod performance, even after controlling for time-invariant characteristics of the pods and hospitals. First, I report results by hospital (i.e., the coordination patterns are nested within the pods within each hospital), and second I report results wherein the coordination patterns from all ten pods are standardized and pooled, and regressed onto throughput time in a multi-level model that controls for pod and hospital effects. This final analysis also serves as the formal test of hypotheses four and five (i.e., that group familiarity and within shift experience are associated with better pod performance).

Results by hospital are reported in Tables 23a-23c. At City Hospital, within shift experience is associated with faster throughput time, as is nurse ego size. At Metro Hospital, more staff per patient, higher group familiarity and within shift experience, and staff ego size are all associated with faster throughput. At Urban Hospital, this same pattern is seen. Finally, Table 24 reports results of a cross-hospital analysis, and the test of hypotheses four and five. Across all hospitals, more staff and resident ego size are associated with faster throughput. Group familiarity is not significantly associated with better pod performance, so the analysis fails to provide support for hypothesis four. Shared patients within shift is significantly associated with better pod performance, which supports hypothesis five.

Table 23a. Regression on Throughput Time for City Hospital Pods

	Model 1 (controls)	**Model 2**
Resources		
Staff per patient		-0.13 (0.68)
Relational		
Group Familiarity		-0.02 (0.33)
Shared Patients		-0.8 (0.06) **
Attending Number of Partners		0.03 (0.02)
Nurse Number of Partners		0.24 (0.5) **
Resident Number of Partners		-0.007 (0.04)
Constant	1.13	3.3
R-sq within	0.21	0.33
R-sq between	0.22	0.85

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 23b. Regression on Throughput Time for Metro Hospital Pods

	Model 1 (controls)	**Model 2**
Resources		
Staff per patient		-2.8 (0.42) **
Relational		
Group Familiarity		-0.06 (0.02) **
Shared Patients		-1.44 (0.14) **
Attending Number of Partners		-0.02 (0.007) +
Nurse Number of Partners		-0.55 (0.5) **
Resident Number of Partners		-0.17 (0.02) **
Constant	4.03	3.3
R-sq within	0.11	0.24
R-sq between	0.39	0.0005

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 23c. Regression on Throughput Time for Urban Hospital Pods

	Model 1 (controls)	**Model 2**
Resources		
Staff per patient		-0.43 (0.2) *
Relational		
Group Familiarity		0.05 (0.02) *
Shared Patients		-0.3 (0.05) **
Attending Number of Partners		-0.03 (0.008) **
Nurse Number of Partners		-0.19 (0.02) **
Resident Number of Partners		-0.14 (0.02) **
Constant	9.9	3.3
R-sq within	0.16	0.22
R-sq between	0.72	0.09

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

Table 24. Across Hospital Pod Performance

	Model 1	**Model 2**
Resources		
Staff per patient		-0.4 (0.12) **
Relational		
Group Familiarity		-0.0002 (0.02)
Shared Patients		-0.4 (0.08) **
Attending Number of Partners		-0.01 (0.04)
Nurse Number of Partners		-0.07 (0.06)
Resident Number of Partners		-0.14 (0.05) **
Constant	-0.4 (0.1)	-0.4 (0.11)
Log Likelihood	-7300.3	-6821.4
Wald chi-squared	689.07**	605.6**

Note +, *, ** denote significance at the 10%, 5%, and 1% level, respectively. Models include, but results are not shown for percentage of patients with acuity levels 1-5 and day of the week.

CHAPTER 6. DISCUSSION

Coordination is a core activity for organizations, and the way organizational structures shape coordination is a vital area of research (Barley & Kunda, 2001; Okhuysen & Bechky, 2009). In my dissertation, I argue that role structures – previously recognized to support de-individualized coordination between relative strangers – may fall short of supporting optimal coordination in some settings. I integrate role theory with team effectiveness theory to conceptualize team scaffolds as *minimal team structures* that bound small groups of roles rather than individuals. I use a multi-method, multi-site research design to provide both evidence and insight into why and how team scaffolds improve coordination, and the conditions that undermine whether minimal teams emerge or endure in role-based settings.

Table 25 reviews the formal hypotheses and research questions developed in chapter one of this dissertation and summarizes the results reported in chapters three through five. First, I implemented a quantitative analysis comparing unbounded role-based coordination with team scaffolds. I found that team scaffolds improved throughput time by 40% at City Hospital, supporting hypothesis one. I also found that the reduction in number of coordination partners caused by team scaffold implementation explained part of this effect, which supports hypotheses two and three. The qualitative analysis reported in chapter three provides insight into the social experience of coordinating in a team scaffold. Interview data revealed that the physician and nurses readily affiliated with their pod teams, which changed the salient in-group during their shift. People felt a de-individualized sense of belonging, which reduced interpersonal risk and increased expectations of account-giving from other role occupants.

Table 25. Formal hypotheses, research questions, and results

Hypothesis or research question	Results
Hypothesis 1: Team scaffolds will improve role-based coordination and performance compared to unbounded role-based coordination.	H1 confirmed: Team scaffoldss improved throughput by 40% at City Hospital
Hypothesis 2: Team scaffolds reduce the number of coordinating partners for each focal role occupant compared with unbounded role-based coordination.	H2 confirmed: Team scaffolds reduced number of partners by four on average at City Hospital
Hypothesis 3: The number of coordinating partners will partially mediate the relationship between team scaffolds and improved performance (H1).	H2 confirmed: Reduction in number of partners explained 40% of the impact of team scaffolds on throughput
How do team scaffolds affect the social experience of role-based coordination?	Team scaffolds changed the salient in-group to be aligned with interdependence; belonging to a shared in-group reduced risk and incraesed expectations of account-giving from other role groups
How are team scaffolds designed and enacted and what are the consequences for how people coordinate?	The way that work was allocated to and within the pods created mismatched ownership that undermined the sense of minimal teams in the pod
Hypothesis 4: Group familiarity (e.g., lifetime weight of ties) is associated with better pod performance.	Support for this hypothesis was not found in a cross-hospital analysis of pod performance
Hypothesis 5: Number of shared patients (e.g., shift weight of ties) is associated with better pod performance.	H5 confirmed: shift weight of ties was associated with faster throughput at every hospital and was significant in a cross-hospital analysis of pod performance

I also conducted a cross-case comparison of pod design, and found that the pods at my other two field sites did not support a sense that the people working together in the pods were a meaningful team. Using descriptions of groupings that did feel like teams and descriptions of the behavioral responses of the pod design, I argued that mismatches in work ownership undermined the feeling of belonging together in a minimal team. Lastly, I conducted an in-depth analysis of pod performance at the various sites. Much of this analysis was exploratory and showed significant variation in the pod concept within Metro and Urban hospital EDs. I conducted a formal analysis of pod performance to test hypotheses four and five and found that group familiarity did not support faster throughput, but the number of shared patients per dyad in each pod did support faster throughput. Thus within shift weight of ties, but not lifetime weight of ties were associated with better pod performance. In some ways this may be expected because role structures are meant to function effectively even in the absence of existing relationships.

Theoretical Implications

The team scaffold conceptualization is useful for future research on role-based coordination. Consider, as an example, three different work situations that rely on role-based coordination. One may be organized solely around role-based coordination. Many air flight crews and many EDs are organized like this, with no attempt to scaffold team-level dynamics. Instead role occupants are focused on completing their individual role responsibilities. A second work situation may involve de-individualized roles being organized into temporary interdependent groups, but without team-level dynamics actually emerging. It may be useful to examine the design and determine whether the depersonalized role set is actually bounded, and to determine the conditions under which the role occupants will indeed experience collective ownership over a whole task. For example, if the pilot and co-pilot in an air crew are separately benchmarked on on-time arrival and the flight attendants are benchmarked on customer satisfaction, the people populating this role structure may be less likely to think of themselves as a team, and less likely to engage in critical teaming behaviors. Similarly, in some EDs, the attending physicians are benchmarked independently and other role groups are not benchmarked at all, a situation that is unlikely to facilitate teaming. Managers might consider the whole task for which a whole group should be responsible and organize a team scaffold around that task. A third work setting might involve a team scaffold that actually functions like a team. In that case, the team scaffold conceptualization may help to explain what makes effective teaming possible, even among strangers. Fluid combat teams, for example, are clearly bounded during a shared mission and may feel co-ownership of the mission, which is a whole and meaningful task. Even if the people populating the team do not have extensive experience working together and are only working together for the duration of that mission, the de-individualized group is effectively scaffolded to form and function like a team.

My findings also have implications for team effectiveness research. There is an emerging body of research recognizing that Van de Ven's (1976) team mode of coordination actually takes myriad forms. Researchers have identified several types of teams in practice that do not fit previous research models that conceptualize teams as stable, bounded entities (Tannenbaum, Mathieu, Salas, & Cohen, 2011). This includes recent research on fluid work teams (Hackman & Katz, 2010; Huckman et al., 2009), multiple-team memberships (O'Leary, Mortensen, & Woolley, 2011), team learning

(Edmondson & Nembhard, 2009), and extreme action teams (Klein et al., 2006). My research suggests that there may be value to designing a team scaffold explicitly, even when people are working together only temporarily, rather than leaving people to self-assemble and work out their own partners and shared tasks in real-time. Further research is required to extend my findings to other settings, but my findings suggest that team scaffolds provided a sort of social or team scaffolding that supported the construction of a team process among fluid groups, which did not happen in the absence of the structure. An explicitly bounded team structure supported a pick-up team mentality even at the extreme level of personnel flux evident in City Hospital. People felt ownership of their pod, their patients, and their pod mates, despite the short durations involved. This shows how the minimal group paradigm may at times create a functional bias that helps people work together effectively, despite irregular shifts and interdependent tasks. Managers might valuably leverage this human tendency to affiliate with groups – even with they are minimally defined – to improve teamwork and coordination among temporary collaborators by setting up team scaffolds.

Practical Implications

The research offers practical insight for ED managers and managers of other flexible, fast-paced work settings. There may be a tendency for ED managers to focus on the physical structure and staffing of ED pods, without paying as much attention to the work design of the pods. My research suggests that the work design can signifcantly undermine the sense that the people working in the pods are a team, even in well-bounded pod structures. As EDs move from individually focused role structures to more team-focused operations, there is risk for mixed messages when the management talks about team-based care and the importance of teamwork, but designs the work with both individual and group level ownership, and uses hierarchy rather than teamwork to accomplish the critical task of patient flow in the ED.

Results from the cross-hospital analysis of pod performance also offer practical insight for managers. The most robust predictor of pod performance was shared patients within a shift. As managers design and staff their pods, it might be valuable to focus on ways to align people's ownership and effort on caring for patients so that they can process patients in parallel and avoid the coordination costs of new and multiple partners.

Limitations and Future Research

In this research, I developed a multi-method, multi-site research design that allowed me to form a deep understanding of the ED research context. Although generalizability is limited by studying team scaffolds in just one context, the focused multi-method design provided an appropriate methodological fit for the current levels of understanding of team scaffolds (Edmondson & McManus, 2007). I leveraged the strengths of quantitative archival and qualitative data at multiple sites. I cannot argue that my findings generalize to other settings. Instead, these findings are suggestive of properties, mechanisms, and consequences of team scaffolds in EDs that can be elaborated in future work.

A second limitation is that the quantitative analysis focused on operational efficiency because the measure of quality was so weak. Because group efficiency goals can be achieved at the sacrifice of quality (Weldon, Jehn, & Pradhan, 1991), and because poor quality in health care is so problematic (IOM, 2001), this is a serious issue. Future work can explore how team scaffolds and role-based coordination affect quality outcomes.

Conclusion

I conclude my dissertation by recalling the ordinary moment of seamless coordination in the City Hospital ED (where team scaffolds were successfully implemented) with which I opened the dissertation. Moments later, a new resident approached the pod, sat at a computer and began reading down the list of patients in the pod. A nurse gestured to her, and the resident stepped in to help take a patient history, thereby immediately being pulled into the flow of patient care tasks. The team scaffold had created a temporary microcosm for inter-role coordination, facilitating interaction, lowering interpersonal risk, and illuminating areas of interdependence. Anyone starting a shift could come in and occupy a place in the role set, effortlessly becoming subsumed into the bounded chaos of the pod. Would all confusion disappear? Of course not. But complex interdependencies were made easier to manage and people were able to act so much like a real team that you could easily mistake them for one. My dissertation explored team design at the limits and discovered that a little structure goes a long way.

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